9-2320-258-20/982

TM 9-2320-258-20

TECHNICAL MANUAL

ORGANIZATIONAL MAINTENANCE MANUAL

TRUCK, TRACTOR,
22-½ TON, 8 x 8, M746
(2320-00-089-7264)

This copy is a reprint which includes current pages from Changes 1 - 2

HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1976

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NO. 2 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 18 October 1982

ORGANIZATIONAL MAINTENANCE MANUAL

TRUCK, TRACTOR, 22-1/2 TON,

8×8, M746

(2320-00-089-7264)

TM 9-2320-258-20, 5 May 1976, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the margin of the page. Added or revised illustrations are indicated by a vertical bar adjacent to the illustration identification number.

Remove Pages	Insert Pages
1-1 and 1-2	1-1 and 1-2
2-7 and 2-8	2-7 and 2-8
None	2-8.1/(2-8.2 blank)
2-137 and 2-138	2-137 and 2-138
None	2-138.1 and 2-138.2
2-193 and 2-194	2-193 and 2-194
2-223 and 2-224	2-223 and 2-224
B-3 through B-6	B-3 through B-6
Index 7 and Index 8	Index 7 and Index 8

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-38, Organizational Maintenance Requirements for 22-1/2 Ton Truck, M746 Series.

WARNING

EXHAUST GASES CAN BE DEADLY

Exposure to exhaust gases produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, coma. Permanent brain damage or death can result from severe exposure.

It occurs in the exhaust fumes of fuel burning heaters and internal combustion engines and becomes dangerously concentrated under conditions of inadequate ventilation.

The following precautions must be observed to insure the safety of personnel whenever fuel burning heater(s) or engine of any vehicle is operated for maintenance purposes or tactical use.

1. Do not operate heater or engine of vehicle in an enclosed area unless it is adequately ventilated.
2. Do not idle engine for long periods without maintaining adequate ventilation in personnel compartments.
3. Do not drive any vehicle with inspection plates or cover plates removed unless necessary for maintenance purposes.
4. Be alert at all times during vehicle operation for

exhaust odors and exposure symptoms. If either are present, immediately ventilate personnel compartments. If symptoms persist, remove affected personnel from vehicle and treat as follows: Expose to fresh air; keep warm; do not permit physical exercise; if necessary, administer artificial respiration.

The best defense against exhaust gas poisoning is adequate ventilation.

Technical Manual
No. 9-2320-258-20

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, DC, *5 May 1976*

ORGANIZATIONAL MAINTENANCE MANUAL FOR

TRUCK, TRACTOR, 22-½ TON, 8 x 8, M746 (2320-00-089-7264)

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual contains instructions for organizational maintenance of the 22½ ton, 8 x 8 truck tractor M746. Information is also provided on organizational maintenance of the equipment, accessories and special purpose kits used in conjunction with the equipment. This manual also includes instructions for domestic shipment and limited storage.

1-2. Maintenance Forms and Records

Maintenance forms and records that you are required to use are explained in TM 38-750.

1-3. Destruction of Army Materiel to Prevent Enemy Use

See TM 750-244-6 "Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use" (US Army Tank-Automotive Command) for instructions.

1-4. Administrative Storage

See TM 740-90-1 "Administrative Storage" for instructions.

1-5. Reporting of Errors

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), direct to: US Army Tank-Automotive Command, ATTN: DRSTA-MB, Warren, MI 48090. A reply will be furnished to you.

Section II. DESCRIPTION AND DATA

1-6. Description

a. General. A general description of M746 truck tractor and its identification plates are in TM 9-2320-258-10. The maintenance paragraphs of this manual contain detailed descriptions of its components.

b. Definition of Location Terms. The term "right", "left", "front" and "rear" refer to sides and areas of the M746 truck tractor as viewed from the driver's seat looking forward.

1-7. Tabulated Data

a. Identification Plates. The following paragraphs identify and locate the identification plates and decals mounted on the accessories and small interchangeable components of the vehicle.

(1) *Starter plate:* Mounted on the starter housing and specifies the manufacturer, part name, voltage, amperage, serial, ordnance and model numbers.

(2) *Alternator plate:* Mounted on housing, left side, and specifies the manufacturer, part name, type, and idle range.

(3) *Voltage regulator plate:* Mounted on top face of housing and specifies the manufacturer, type, serial and Federal or National Stock numbers, voltage, amperage, and ground instructions.

(4) *Primary fuel filter (strainer) decal:* Located on the housing and specifies the manufacturer, type, element type, and includes maintenance and draining instructions.

(5) *Secondary fuel filter decal:* Located on the housing and specifies the manufacturer, type, element type, and includes maintenance draining instructions.

(6) *Fan drive plate:* Mounted on shoulder of clutch housing cover assembly and specifies the manufacturer, part name, and serial number.

(7) *Winch power take-off plate:* Mounted on housing and specifies the manufacturer, model, and assembly number.

(8) *Air compressor plate:* Mounted on housing, topside, and specifies the manufacturer, model, serial and piece number.

(9) *Transmission oil filter decal:* Located on the filter shell.

(10) *Starter relay plate:* Mounted on the relay body.

(11) *Windshield wiper motor decal:* Located on the non-drive end of the housing and specifies the manufacturer and part number.

(12) *Winch hydraulic pump plate:* Embossed on casing end and specifies the manufacturer and part name.

(13) *Winch hydraulic motor plate:* Mounted on the

housing and specifies the manufacturer, the serial, control, and Federal or National stock numbers, and the maximum capacity rating.

(14) *Winch plate:* Mounted on the outboard drum face and specifies the manufacturer, model, the serial, part, ordnance, and Federal or National stock numbers.

(15) *Personnel heater plate:* Located on the heater body.

(16) *Personnel heater fuel pump decal:* Located on pump housing and specifies the manufacturer and part name.

(17) *Personnel heater blower plate:* Mounted on the blower body.

(18) *Power steering auxiliary pump plate:* Mounted on the pump body.

b. Tabulated Data. For pertinent data not covered in this paragraph, refer to TM 9-2320-258-10.

(1) *Air cleaner*

Capacity	1315 cu ft/min

(2) *Cooling system*

Radiator working pressure	7 psi
Thermostat operating range	120°F to 185°F

(3) *Wheels*

Rim dish depth	3.5 in.
Bolt circle	13.189 in.

(4) *Steering*

Steering gear ratio	19-24-19
Steering wheel diameter	20 in.
Turns of steering wheel	5.6
Usable steering arm arc	76°
Pump, main	
Drive	Belt
Location	Engine
Pump, auxiliary	
Drive	Direct
Location	Axle No. 1
Hydraulic operating pressure	1450 psi

(5) *Brake system*

Brakes	
Type	Wedge action
Size (axle 1 and 2)	17.25 x 4 in
(axle 3 and 4)	17.00 x 7 in
Air tanks	
Total volume	8502 cu in.

(6) *Electrical system*

Alternator (with rectifier)	
Make	Ordnance
Voltage	28v
Amperage	100 amp
Drive	Belt
Regulator	
Make	Ordnance
Voltage	28v
Amperage	100 amp
Circuit breakers	
Quantity	10
Type	Thermal break, automatic reset
Batteries	
Number required	6
Connected	In series parallel
Capacity	300 amp hr
Wiring	
Type	Standard Ord., waterproof cable
Circuits	Single wire, ground return

(7) *Loading system*

Hydraulic motor	
Maximum hp	74
Capacity	63.8 gal/min
Maximum pressure	1450 psi

(8) *Accessories*

Personnel heater	
Model	10560A24
Type	Fuel fired
Capacity	60,000 btu
Input voltage	24 vdc

CHAPTER 2
MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

2-1. Inspecting and Servicing the Equipment

a. Separately packed components on an M746 truck tractor received by the using organization must be unpacked and installed by the using organization. Refer to paragraph 2-2.

b. If any exterior surfaces are coated with rust-preventive compound remove compound with dry-cleaning solvent or mineral spirits paint thinner.

c. Read the Processing and Deprocessing Record for Storage and Issue of Vehicles and Spare Engines (DD Form 1397) and follow all precautions checked thereon. DD Form 1397 should be in the cab, wired to either the steering wheel, transmission shift lever, or starting switch.

d. Flush cooling system and refill with clean water and proper amount of new antifreeze agent. Check antifreeze capability of coolant using an accurate hydrometer. (Accurate hydrometer will read 0°F when applied to a solution of 1 part ethylene glycol antifreeze to 2 parts water.) Refer to table 2-1. After performing *e* and *f* below, add antifreeze as required, and fasten tag near radiator filler cap indicating type of antifreeze.

e. Add distilled water to dry charged batteries and allow sufficient time for batteries to energize. Refer to TM 9-6140-200-12. Assure that cable terminals are tight on battery terminal posts.

f. Crank engine with starter at least two revolutions while applying fuel cut-off switch to test for hydrostatic lock. This precaution is taken because there might be an excess of preservative oil in the cylinders, or other liquid may have leaked into them.

Table 2-1. Freezing Points, Composition, and Specific Gravities of Military Antifreeze Materials

Lowest expected ambient temp. °F	Pints of inhibited glycol per gal. of coolant [1]	Compound antifreeze Arctic [2]	Ethylene glycol coolant solution specific gravity at 68°F
+20	1½	Issued full strength and ready mixed for 0° to -65°F temperatures for both initial installation and replenishment of losses. DO NOT DILUTE WITH WATER OR ANY OTHER SUBSTANCE.	1.022
+10	2		1.036
0	2¾		1.047
-10	3¼		1.055
-20	3½		1.062
-30	4		1.067
-40	4¼		1.073
-50	Arctic antifreeze preferred		
-60			
-75			

[1] Maximum protection is obtained at 60 percent by volume (4.8 pints of ethylene glycol per gallon of solution).

[2] Military Specification MIL-C-11755 Arctic type, nonvolatile antifreeze compound is intended for use in the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic regions where the ambient temperature remains for extended periods close to -40°F or drops below, to as low as -90°F.

g. Perform following services for cold weather starting, if applicable.

h. Perform the "S" preventive maintenance checks and services as outlined in table 2-3.

j. Before starting road test, lubricate points illustrated in Lubrication Order, LO 9-2320-258-12, regardless of interval, excluding gear cases and engine. Check DD Form 1397 in cab for gear case and engine oil. If DD Form 1397 states that oil is suitable for 500 miles of operation and is of the proper viscosity for local climatic operation, check oil level but do not change oil.

k. Refer to TM 9-2320-258-10 for M746 truck tractor operating instructions. Road-test the vehicle for at least 50 miles unless vehicle was driven to using organization. In this case, make the road test only long enough to conduct the usual operations. Stop at least every 10 miles and make visual checks around vehicle; look particularly for overheated drive and steering components.

l. Schedule next "S" preventive maintenance service.

m. After first 100 hours of operation, refer to LO 9-2320-258-12. Change transmission oil and filter, clean transmission oil strainer, and clean torque converter scavenge pump oil strainer element.

Section II. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-2. Common Tools and Equipment

General mechanic's tool sets and common tool sets required for maintenance on this material are authorized by the Table of Allowances (TA) and the Tables of Organization and Equipment (TOE).

2-3. Special Tools and Equipment

Certain tools and equipment specially designed for organizational maintenance and repair of the materiel are listed in table 2-2 for information only. This list is not to be used for requisitioning replacements. Special tools for organizational maintenance are listed in TM 9-2320-258-20P, which is the authority for requisitioning replacements.

Table 2-2. Special Tools and Equipment

Item	NSN or reference No.	Fig. No.	Para. No.	Use
Adapter	4730-00-719-2617 4-6F50XSS	2-1	2-172*b*	Used with gage 10946819 (winch pressure).
Adapter	4730-00-289-5484 4-4FBTXS	2-1	2-141*c*	Used with oil pressure gage 10946819 (P/S pressure).
Brush, fiber	CPR 109386	2-1	2-37*a*	Clean airbox drain tubes.
Pliers	5120-00-540-4022	2-1	2-119*a*	Remove and install brake return spring.
Driver	5120-00-262-1412 CPR 102296	2-1	2-131	Install outer wiper on axle 3 and 4 spindle.
Driver	5120-00-269-8224 CPR 109379	2-1	2-131	Install wiper and seal assembly on axle 3 and 4 spindle.
Driver	5120-00-143-2751 CPR 102298	2-1	2-131	Install hub inner oil seal on axle 3 and 4.
Driver, kit assembly	5120-00-269-0244 CPR 104433	2-1	2-110	Install trunnion socket bushing.
Gage, oil pressure	6685-00-754-4111 10946819	2-1	2-141 2-172	Used for hydraulic troubleshooting.
Handle	5120-00-977-5578 J7079-2	2-1	2-54	Used with installer CPR 109389.
Handle	5120-00-176-8879 7950113	2-1	2-130 2-131	Used with driver's CPR 102296, CPR 102297, CPR 102298, CPR 109755 and replacer CPR 102294.
Installer	5120-00-977-5579 J8550	2-1	2-54	Install thermostat seals.
Key, socket head screw	5120-00-889-2163 GGG-K-275	2-1	2-168	Hydraulic filter dial indicator setscrew.
Puller Assembly	5120-00-262-1414 CPR 104422	2-1	2-138	Remove steering arm.
Remover and installer	5120-00-279-8422 CPR 109701	2-1	2-153	Remove and install window glass (cab top and windshield).
Replacer	5120-00-143-2025 CPR 102294	2-1	2-130	Install hub inner oil seal on axle 1 and 2.
Tire iron	5120-00-177-6792 T45	2-1	2-129	Remove and install tires.
Tire iron	5120-00-177-6793 T46B	2-1	2-129	Remove and install tires.
Tire iron	5120-00-177-6794 T46C	2-1	2-129	Remove and install tires.
Wrench	5120-00-490-5579 CPR 102292-2	2-1	2-130	Wheel bearing nuts.
Tube assembly	12255053	2-1	2-172	Winch hydraulic pressure test.

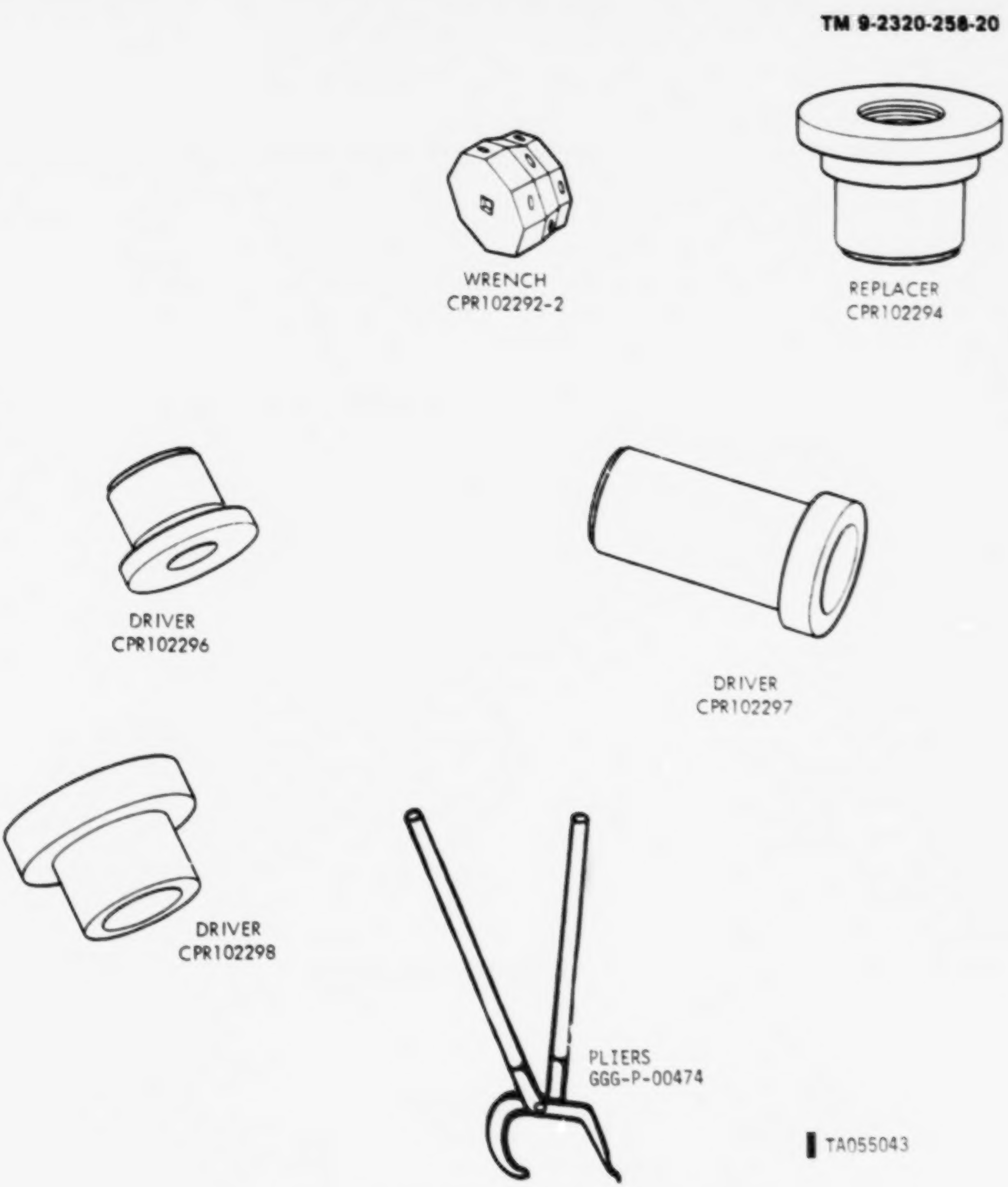
WRENCH
CPR102292-2
REPLACER
CPR102294
DRIVER
CPR102296
DRIVER
CPR102297
DRIVER
CPR102298
PLIERS
GGG-P-00474
TA055043

Figure 2-1. Special tools (1 of 4).

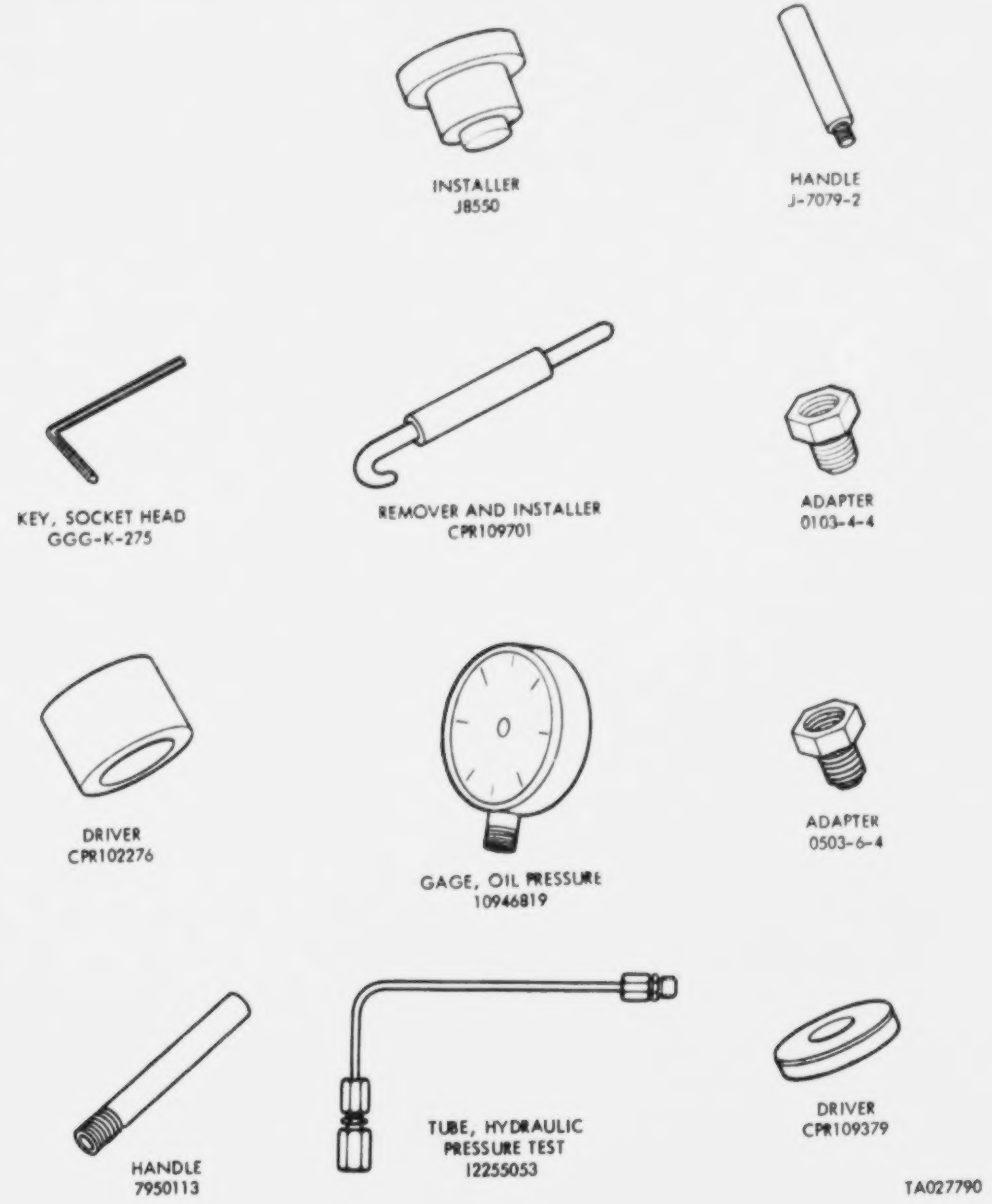
INSTALLER
J8550
HANDLE
J-7079-2
KEY, SOCKET HEAD
GGG-K-275
REMOVER AND INSTALLER
CPR109701
ADAPTER
0103-4-4
DRIVER
CPR102276
GAGE, OIL PRESSURE
10946819
ADAPTER
0503-6-4
HANDLE
7950113
TUBE, HYDRAULIC
PRESSURE TEST
12255053
DRIVER
CPR109379
TA027790

Figure 2-1. Special tools (2 of 4).

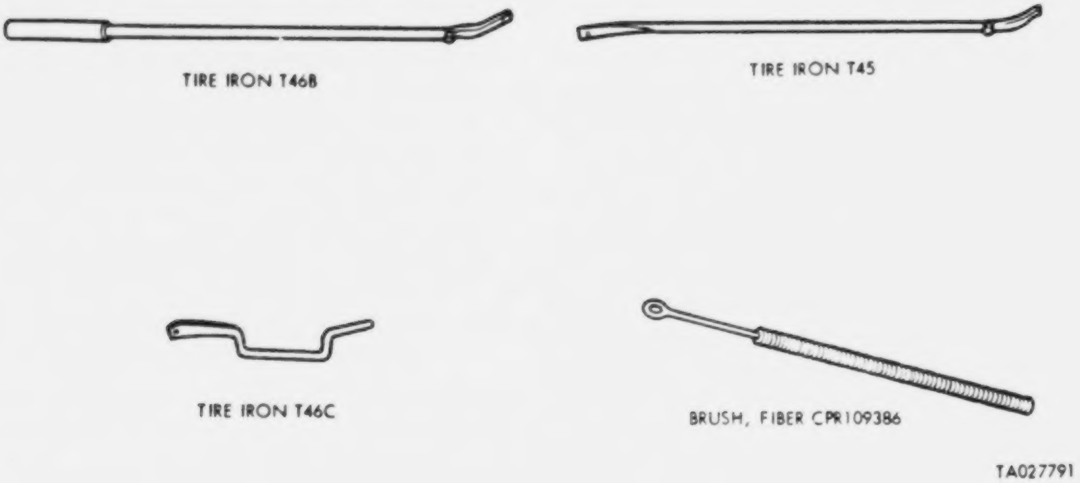
TIRE IRON T46B
TIRE IRON T45
TIRE IRON T46C
BRUSH, FIBER CPR109386
TA027791

Figure 2-1. Special tools (3 of 4).

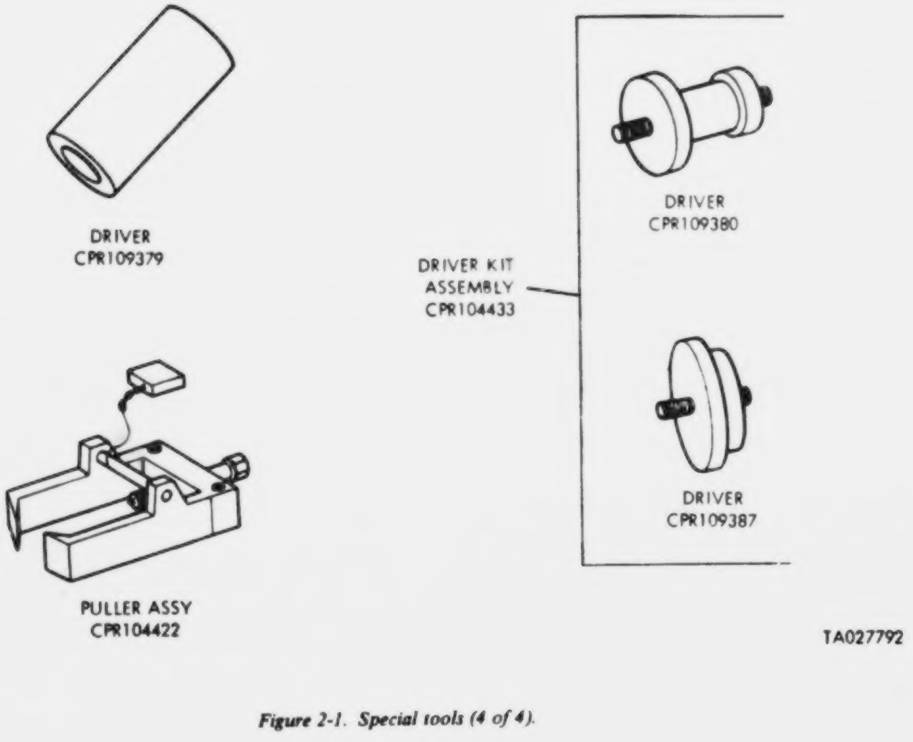
DRIVER
CPR109379
DRIVER
CPR109380
DRIVER KIT
ASSEMBLY
CPR104433
DRIVER
CPR109387
PULLER ASSY
CPR104422
TA027792

Figure 2-1. Special tools (4 of 4).

2-4. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated in the repair parts and special tools list covering organizational maintenance for this equipment in TM 9-2320-258-20P.

Section III. LUBRICATION AND PAINTING INSTRUCTIONS

2-5. General

a. The cleaning and lubricating procedures as to location, intervals, and proper materials, are prescribed in the Lubrication Order, LO 9-2320-258-12. Refer to the lubrication order for localized views of lubrication points.

b. Any special lubricating instructions required for specific mechanisms or parts are contained in pertinent sections of this, or the following, chapters.

c. Maintain a record of lubrication of the materiel.

2-6. General Lubrication Instructions Under Unusual Conditions

Reduce service intervals specified on LO 9-2320-258-12, i.e., lubricate more frequently to compensate for abnormal or extreme conditions, such as high or low temperatures, prolonged periods of high speed operation, continued operation in sand or dust, immersion in water, or exposure to moisture. Any one of these conditions may cause contamination and quickly destroy protective qualities of lubricants. Intervals may be extended during inactive periods commensurate with adequate preservation.

2-7. Lubrication for Continued Operation Below 0°F

Refer to TM 9-207 for instructions on necessary special preliminary lubrication of the vehicle.

2-8. Lubrication After Fording Operations

Lubrication as soon as possible after fording is extremely important. Follow "S" semiannual lubrication instructions detailed in LO 9-2320-258-12.

a. Repack wheel bearings.

b. Repack CV (constant velocity) joints and trunnion-socket assembly, if necessary. Inspect lube by removing plug 16, figure 2-164, and partially detaching rubber boot.

c. Repack brake plungers.

d. Drain and fill axles and differential carriers.

e. Check steering gear.

2-9. Lubrication After Operations Under Dusty or Sandy Conditions

During continuous operations under dusty or sandy conditions, reduce lubrication interval by 50 percent.

2-10. Painting

a. General. Instructions for the preparation of the materiel for painting and methods of painting are contained in TM 43-0139. Instructions for camouflage painting are contained in FM 5-20. Painting of a complete tactical vehicle can be authorized and performed only by direct support personnel.

b. Walkways. Surfaces shaded on figure 2-2 should be coated with walkway compound, non-slip, MIL-W-5044, Type II, color OD, Fed Std 595. However, if surfaces become wet from lubricating oils or hydraulic fluids, flight deck compound, non-slip, MIL-D-23003, should be used.

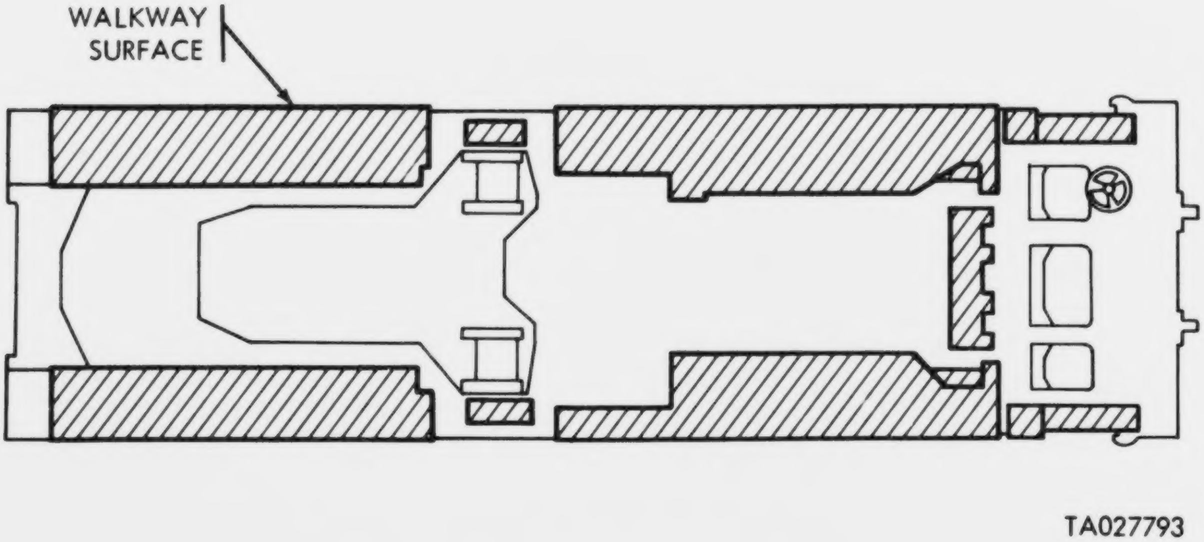

Figure 2-2. Coating of walkway surfaces.

2-11. Vehicle Stenciling

a. General instructions are contained in TB 746-93-1.

b. Stenciling of vehicles will be performed under the control of organizational maintenance personnel. Drivers or operators are not authorized to perform this function, except in cases where the operator is also a mechanic or mechanic's helper. See figure 2-3 for stencil-marking locations.

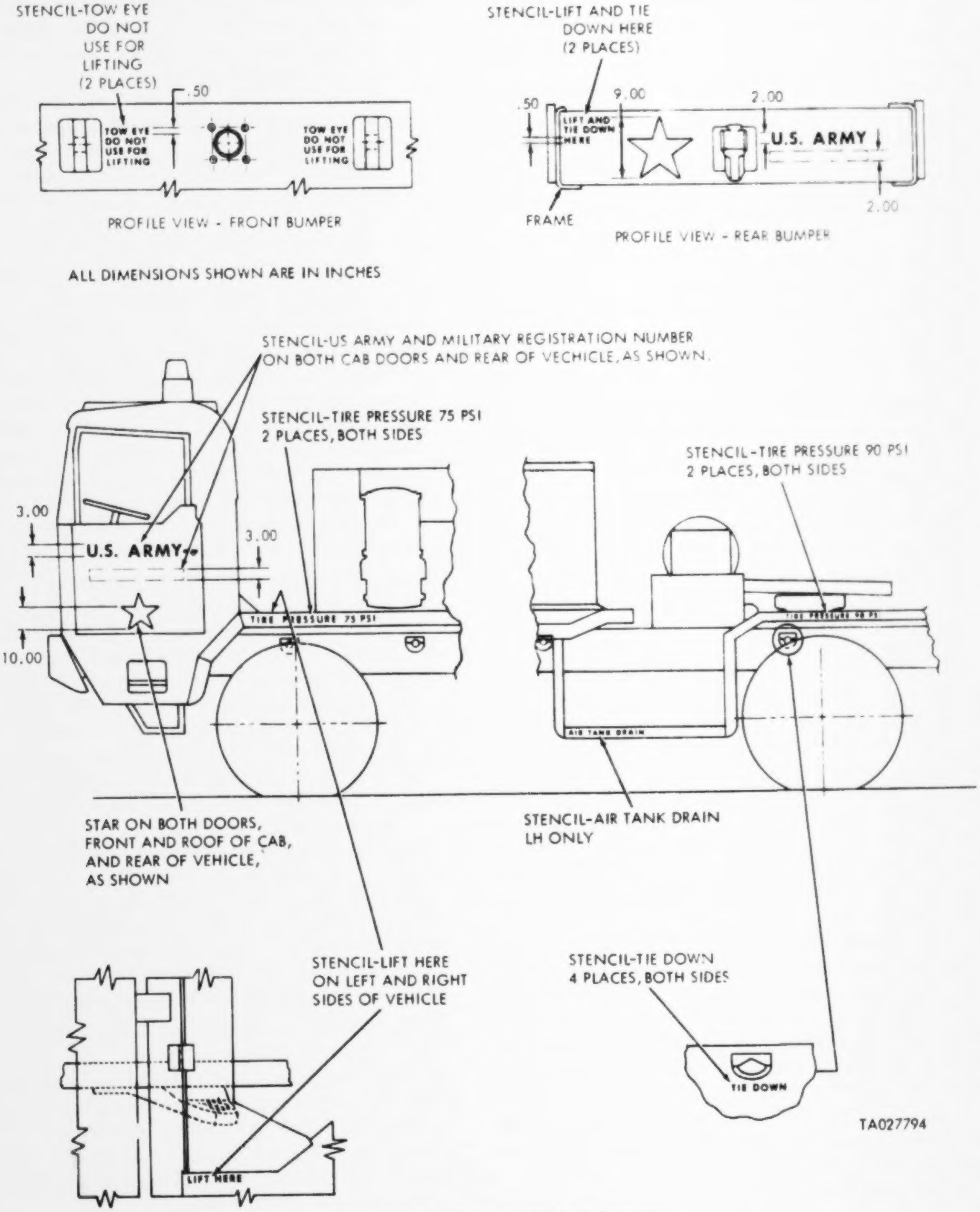
STENCIL-TOW EYE DO NOT USE FOR LIFTING (2 PLACES)
.50
TOW EYE DO NOT USE FOR LIFTING
TOW EYE DO NOT USE FOR LIFTING
PROFILE VIEW - FRONT BUMPER
ALL DIMENSIONS SHOWN ARE IN INCHES
STENCIL-LIFT AND TIE DOWN HERE (2 PLACES)
.50
9.00
2.00
LIFT AND TIE DOWN HERE
U.S. ARMY
2.00
FRAME
PROFILE VIEW - REAR BUMPER
STENCIL-US ARMY AND MILITARY REGISTRATION NUMBER ON BOTH CAB DOORS AND REAR OF VECHICLE, AS SHOWN.
STENCIL-TIRE PRESSURE 75 PSI 2 PLACES, BOTH SIDES
STENCIL-TIRE PRESSURE 90 PSI 2 PLACES, BOTH SIDES
3.00
U.S. ARMY
3.00
10.00
TIRE PRESSURE 75 PSI
TIRE PRESSURE 90 PSI
AIR TANK DRAIN
STAR ON BOTH DOORS, FRONT AND ROOF OF CAB, AND REAR OF VEHICLE, AS SHOWN
STENCIL-AIR TANK DRAIN LH ONLY
STENCIL-LIFT HERE ON LEFT AND RIGHT SIDES OF VEHICLE
STENCIL-TIE DOWN 4 PLACES, BOTH SIDES
TIE DOWN
LIFT HERE
TA027794

Figure 2-3. Stenciling the M746 truck tractor.

Section IV. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-12. General Procedures

a. Operator's Procedures. All of the general procedures given for operator's preventive maintenance, TM 9-2320-258-10, will be followed.

b. Operator Participation. The vehicle operator usually accompanies the vehicle and assists the organizational mechanics in the performance of periodic services.

c. Unwashed Vehicle. The vehicle operator should present the vehicle for scheduled preventive maintenance services in a reasonably clean condition; that is, it should be dry and not caked with mud to such an extent as to seriously hamper inspection and services. However, washing of the vehicle should be avoided immediately prior to an inspection, since certain types of defects such as loose parts and oil leaks may not be evident immediately after washing.

d. Plates. Name plates, caution plates, and instruction plates should be thoroughly cleaned and heavily coated with an application of lacquer (refer to TM 43-0139).

e. Services. Organizational maintenance services are defined by, and restricted to, requirements delineated in the Maintenance Allocation Chart, Appendix B.

f. Inspection.

(1) Inspection for "good condition" is usually a visual inspection to determine whether the unit is damaged beyond safe or serviceable limits. Good condition means that a component or part is not bent or twisted, not chafed or burred, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, or not deteriorated.

(2) Inspection of an item to see that it is correctly assembled or stowed is usually a visual inspection to see if the item is in its normal position in the vehicle, and if all its parts are present and in their correct relative position.

(3) Inspection of an item to determine if it is "secure" is usually a visual examination or a check by hand, wrench, or pry-bar for looseness. Such an inspection must include any brackets, lockwashers, locknuts, locking wires, or cotter pins as well as any connecting tubes, hoses, or wires.

(4) "Excessively worn" means worn beyond serviceable limits or to a point likely to result in failure if the item is not replaced before next scheduled inspection. Excessive wear of mating parts or linkage connections is usually evidenced by too much play (lash or lost motion). It includes illegibility as applied to markings, data, and caution plates.

(5) Where the instruction "tighten" appears in the procedure, it means tighten with a wrench, even if the item appears to be secure.

g. Cleaning. (See Table 2-2.1)

(1) Use dry-cleaning solvent to clean or wash grease or oil from all metal parts.

(2) A solution of one part grease-cleaning compound to four parts of dry-cleaning solvent may be used for dissolving grease and oil from engine castings, components, and engine compartments. After cleaning, use cold water to rinse off any solution which remains on the item being cleaned.

(3) After the parts are cleaned, rinse and dry them thoroughly. Apply a light grade of lubricating oil to all unprotected metal surfaces to prevent rusting.

(4)When authorized to install new parts, remove any preservative materials, such as rust-preventive compound, grease, etc., prepare parts as required (oil seals, etc.); and for those parts requiring lubrication, apply the lubricant prescribed in LO 9-2320-258-12.

2-13. Recording Repairs

The equipment record system provides for recording repairs required and accomplished on specific items of equipment. This will include, but is not limited to, adjusting, cleaning, replacing, and straightening. Deficiencies and shortcomings not corrected by the operator, or those discovered during periodic inspections, will be corrected insofar as possible by organizational maintenance personnel. These repairs will be indicated on DA Form 2404 and recorded on the organizational maintenance record of the equipment log.

2-14. Semiannual "S" and Annual "A" Preventive Maintenance Services

a. Intervals. The semiannual "S" preventive maintenance services are performed by the organizational mechanics every 6 months or at every 6,000 miles of vehicle operation, whichever occurs first. The annual "A" preventive maintenance services are performed by the organizational mechanics at 12 months or 12,000 miles of vehicle operation, whichever comes first. Refer to Lubrication Order LO 9-2320-258-12.

b. Purpose. The semiannual "S" and annual "A" preventive maintenance services assure the correct adjustment, securing, and assembly of all components of the vehicle. Necessary replacements, cleaning, lubrication, and protection of parts and/or assemblies will be accomplished, as required, to give reasonable assurance of trouble-free operation until the next scheduled maintenance services are performed.

2-15. Specific Procedures for Organizational Maintenance.

Specific procedures for the performance of the semiannual "S" and annual "A" services for the tractor are given in the following table. The semiannual "S" portion appears first, the annual "A" second. The procedures fall in numerical sequence and are arranged to provide ease of maintenance

Table 2-2.1

DRY CLEANING QUANTITIES

Solvent, Dry Cleaning, Type II
(SD-2), Fed. Spec (P-D-680)

NSN	QTY
6850-00-110-4498	1 Qt.
6850-00-274-5421	5 Gal.
6850-00-281-1985	6 Gal.
6850-00-664-5685	24 Qts.
6850-00-281-8011	55 Gal.
6850-00-637-6135	Bulk

Table 2-3. Organizational Preventive Maintenance Checks and Services

S - Semi-annually
Total man-hours required: 15.0

Sequence number	ITEM TO BE INSPECTED PROCEDURE	Work time (M/H)
	BEFORE STARTING ENGINE	
1	**TIRES** Inspect tires for unusual wear, improper front-end alinement, penetrating objects and improper matching (para 2-129). If required, rotate and match tires according to tread design and degree of wear. Inflate or deflate to proper pressure - 75 psi front, 90 psi rear. Replace tire if average tread depth is 3/32-inch or less. Reference table 2-3 of -10 manual.	0.4
2	**WHEEL AND WHEEL MOUNTING** Inspect cap nuts. Look for unusual rust pattern around cap nuts (usually an indication of looseness). If rust is present, remove wheel, check for damaged studs; if serviceable, remount wheel and torque cap nuts to 650-750 lb-ft. (para 2-129).	0.3
3	**LEAKS** Make general observations under engine compartment and front axle for oil, fuel, and water leaks; also underneath steering gear housing, torque converter, transmission-transfer and rear axles for leaks.	0.4
4	**ENGINE** Clean engine air box drain tubes.	0.2
5	**CHASSIS** Check for damaged, cracked, or broken frame and crossmembers. Notify support maintenance.	0.5
6	**POWER TRAIN** Inspect propeller shaft, U-joints, and flanges for serviceability. Inspect for evidence of lube leakage at yoke seals or loose yoke bolts (para 2-105). Inspect differential carrier mounting nuts and bolts for tightness. If leaking yoke seal or loose mounting nuts on carrier are found, perform troubleshooting on connecting drive shaft (table 2-6).	0.4
7	**FUEL SYSTEM** Drain water and sediment from fuel tank. Replace fuel filter and fuel strainer elements. Check fuel shut-off valve handles for proper operation (para 2-42).	0.6
8	**FRONT AND REAR SPRINGS** Inspect condition of springs and shock absorbers. Inspect condition of rebound cables and jounce pads. Replace any that are badly damaged or missing. Use a wrench to check for loose spring U-bolt nuts. Notify support personnel for proper torque application on loose U-bolt nuts (para 2-112).	0.3
9	**TOWING PINTLE** Check operation of towing pintle.	0.1
10	**FIFTH WHEEL AND KING PIN GUIDE RAIL** Tighten assembly and mounting bolts. Test operation of plunger lock and coupler lock. Check for loose bolts on the kingpin guide rail mounting plate.	0.2
11	**TRAILER AIR HOSES AND ELECTRICAL CABLE** Inspect trailer air hose and connectors. Check condition of electrical trailer plugs and cable.	0.2
12	**WINDSHIELD WIPER ARMS AND BLADES** Check for security of arms on mounting shafts. Check condition of wiper blades.	0.1
13	**CAB AND BODY** Inspect doors, hardware, hardtop, seats, windshield frame and glass. Check mountings and springs. Operate doors, windshield, hinges and fasteners. Make a general inspection of body, including fenders, walkways and tool compartments. Examine condition of paint and check markings, legibility of caution and identification plates. If cab mounting bolts require tightening, loosen steering column clamp (para 2-157). Tighten cab bolts and tighten steering column clamp (after adjusting column height) (para 2-134).	0.5
14	**RADIATOR** Inspect radiator core, shell, hoses, cap, and gaskets. Notice if radiator fins are clogged with foreign matter or if fins are bent. Radiator must be filled to filler neck. If required, drain radiator and cylinder block, flush, and refill cooling system and add rust inhibitor, unless antifreeze containing rust inhibitor is used (para 2-49*c*).	0.2
15	**ANTIFREEZE PROTECTION** Test with hydrometer to determine if sufficient antifreeze is present for regional conditions (TB 750-651 and para 2-1*d*). Tighten radiator mounting and hose clamps as required. Check radiator cap and gasket (para 2-48*a*).	0.6
16	**WATER PUMP, FAN, PULLEY, AND ALL DRIVE BELTS** Check for leaks. Inspect pulleys and fan for alinement and belts for proper tension. Belt deflection should be 1/8-3/16 inch under a force of 12 pounds at center of belt span of each belt. Change belts as a set if one or more belt is defective (para 2-52).	0.3

Table 2-3. Organizational Preventive Maintenance Checks and Services - Continued

Sequence number	ITEM TO BE INSPECTED PROCEDURE	Work time (M/H)
17	ACCELERATOR AND THROTTLE CONTROLS Inspect accelerator noticing if shafts and linkage operate freely and are not worn excessively. Observe that accelerator opens fully when depressed. Inspect throttle noticing if cable binds or does not open accelerator. Inspect throttle control cable at winching station (para 2-45).	0.2
18	OIL SYSTEM Follow Lubrication Order. Check oil levels. Check oil filters for leaks and lines for possible breaks.	
19	AIR COMPRESSOR Examine to see that it is in good condition and properly alined and secured. Inspect for oil leaks at oil line fittings. Belt deflection should be 3/8-1/2 inch under a force of 12 pounds at center of belts. Replace belts as a set if necessary (para 2-128). Inspect tube fitting and tube to alcohol evaporator. Clean and refill alcohol container.	0.3
20	ENGINE ELECTRICAL COMPONENTS Inspect alternator and starter bolts for tightness and general condition (para 2-56 and 2-57). Inspect wiring for loose connections or worn insulation. Check condition and tension of alternator drive belts. Belt deflection should be ½-¾ inch under a force of 12 pounds at center of belts. Replace belts as a set, if necessary. Check electrical connectors for tightness.	0.5
21	MAIN POWER STEERING PUMP Inspect for seepage or leaks at housing and pressure hoses (para 2-139). Inspect for leaks or seepage at the housing, pressure hoses or fittings on the transfer case lube and scavenge pumps (para 2-99). Replace the drive belts if badly worn or frayed. Adjust if loose.	0.3
22	BRAKES Inspect air hoses, fittings, chamber, and cylinder linkage for looseness. Open drain valve on air reservoirs and drain moisture that has collected.	0.4
23	STEERING CONTROLS Inspect auxiliary steering pump, fittings, and lines for evidence of leakage (para 2-140). Check position of the restriction indicator on winch reservoir filter and clean filter as required (para-2-168). Check oil level in reservoir. Inspect steering gear for evidence of lube leakage. Push back the boot covering the steering swivel coupling and inspect the condition of the lube. Clean and lube if contaminated. Examine steering column for alinement.	0.7
	IN CAB CHECKS	
24	WARNING LIGHTS, BUZZER AND INDICATOR LIGHTS Turn starter switch ON and observe that the following warning lights are illuminated: 1. TRANS-ENGINE warning light 2. TRANS LO PRESS warning light 3. STEERING AUX warning light 4. TRACTOR AIR PRESSURE warning light (only if reservoir pressure gage indicates less than 65 psi in reservoir). Low air buzzer should also sound. 5. Check press-to-test feature on remaining indicators.	0.2
	START ENGINE	
25	STARTER Observe that the starter engages smoothly without unusual noise and turns engine with normal cranking speed.	0.1
26	ENGINE Observe that TRANS-ENGINE warning light goes out within 15 seconds after start of engine and the ENGINE OIL pressure indicates oil pressure. If no pressure is indicated and the light stays on, stop engine immediately and check engine lube system. Idling speed should be 650 rpm and operating temperature between 160°F and 180°F. Normal engine oil pressure is 25 psi or about at 1200 rpm.	0.1
27	INSTRUMENT PANEL Observe all instruments for normal readings. Check controls, including parking/emergency brake control valve, for normal operation. Note alternator output on battery indicator immediately after starting engine, before regulator has reduced the charging rate of alternator. Battery-generator should be in the green range.	0.2
28	AIR PRESSURE CUTOFF POINT Governor cut-out pressure is 95 to 120 psi. With engine running, slowly reduce air pressure by depressing and releasing brake treadle and note pressure on gage at which compressor resumes pumping. This is the governor cut-in pressure and should be 90 psi (para 2-128). Check air system for audible air leaks. Stop engine, release the parking brake and fully depress the service brake treadle and hold for 2 minutes while noting pressure gage and listening for leaks. Reservoir pressure should not drop more than 6 psi. If drop is greater than 6 psi check system for leaks (para 2-122w).	0.2

Table 2-3. Organizational Preventive Maintenance Checks and Services - Continued

Sequence number	ITEM TO BE INSPECTED PROCEDURE	Work time (M H)
29	SAFETY DEVICES Sound horn (if tactical situation permits). Test windshield wipers for proper operation. Check windshield washer for proper operation. Check mirrors for damage or looseness. Check all lights.	0.2
30	STEERING Turn the steering wheel through its entire range and note any bind. Check for loose or worn tie rods and drag links. Check for loose idler arm mounting bolts and loose steering cylinder clamp bolts on tie-rods.	0.3
31	INTAKE AND EXHAUST MANIFOLDS Inspect for condition. Look for signs of leakage at the manifold gaskets.	0.1
32	VALVE COVERS Inspect valve covers for leaks.	0.1
33	EXHAUST PIPES Check mountings for tightness. Listen for excessive noises and inspect for exhaust leaks. Check that exhaust stack rain caps are operating freely.	0.1
	ROAD TEST	
34	TACHOMETER Observe that tachometer functions satisfactorily.	0.1
	WARNING Engine speed must not exceed 2700 rpm at any time.	
35	PERFORMANCE When operating vehicle, observe if speedometer functions satisfactorily, notice if it has normal power and acceleration in each gear or range, if there is a lack of power, engine misfires or excessive exhaust smoke is noted. Check troubleshooting instructions for diagnosis of malfunction (table 2-4). Listen for any unusual noises when engine is under load. Check to see that governor is functioning in accordance with speeds on data plate.	0.2
36	TRANSMISSION TRANSFER Shift transmission into all speeds. Check shift quadrant for smooth operation. Observe that transmission goes in and out of lock-up. Check retarder operation.	0.2
37	STEERING WARNING LIGHTS AND STEERING Check that AUX steering warning light goes off and stays off at vehicle speed above 4 mph. When truck is in motion, check for wander, shimmy, side pull, or excessive free play.	0.1
38	UNUSUAL NOISES Cab and body attachments. Check for excessive noise that may indicate looseness. Also observe similar conditions on wheels and powertrain which could also be a lack of lubrication.	0.2
39	BRAKES Note braking effect. Feel side pull, noise or chatter and smooth application. Stop on an incline and apply brakes to see that they hold the vehicle. When towing semitrailer or equipment with electrically operated brakes, apply these brakes alone and observe if they operate satisfactorily.	0.2
	AFTER ROAD TEST	
40	TEMPERATURE Immediately after road test, cautiously feel brake drums, hubs, axle housing, carriers-differentials, and transmission-transfer case. An overheated wheel hub and brake drum indicates an improperly adjusted, defective or dry wheel bearing or a dragging brake. An abnormally cool condition indicates an inoperative brake.	0.3
41	BRAKES, WHEEL, AND AXLE SHAFT MOUNTING If there has been a brake deficiency indicated in previous stops or during the road test, teardown will be extended only to accomplish necessary repair (para 2-119 and para 2-120). Re-torque wheel cap nuts only if wheel has been removed since last torquing by organizational personnel.	0.2
42	WINCHES Test operation of winches. Check operation of winch controls. Clean exposed portion of valve spools and exercise if they stick. Pull vent piston on each winch. Piston must move freely.	0.4
43	LUBRICATION Lubricate vehicle in accordance with lubrication order (LO 9-2320-258-12).	2.4
44	FIRE EXTINGUISHER Check that they are full. See weighing instructions on extinguisher. Check condition of stowage brackets.	0.1

Table 2-3. Organizational Preventive Maintenance Checks and Services - Continued

Sequence number	ITEM TO BE INSPECTED PROCEDURE	Work time (M H)
45	FINAL ROAD CHECK Perform final road test to ensure that operational deficiencies have been corrected. Pay particular attention to those items which have just been repaired or adjusted. Correct any remaining deficiencies that show up on this test run.	
	NOTE To perform the "A" annual or 12,000 mile preventive maintenance checks and services, refer to and perform the "S" semiannual preventive maintenance in addition to the procedures listed below:	
1	FRONT WHEELS Inspect brake linings (para 2-119). Replace shoe/lining if worn to within 1/32 inch of the rivet head, or if lining is expected to wear more than 1/32 inch before next "A" annual service because of operating conditions, or if lining is damaged by grease or other substances that could cause drag, lockup or slippage. Refer to LO 9-2320-258-12 for lubrication of wheel bearings, kingpin bearings, CV joints, spindle ball surface, brake plungers and actuators (para 2-130). Inspect axle seals and replace if damaged or if there is axle lube (GO) (or trunnion socket grease) in the CV joint (para 2-108). Remove the guards and inspect the CV joint boots for splits, tears or punctures. Replace damaged boots.	10.0
2	REAR WHEELS Inspect brake linings (para 2-120*a*). Replace shoe/lining if worn to within 1/32 inch of rivet head, or if lining is expected to wear more than 1/32 inch before the next "A" annual service because of operating conditions, or if lining is damaged by grease or other substance that could cause drag, lockup or slippage. Refer to LO 9-2320-258-12 for lubrication of wheel bearings, brake plungers and actuators (para 2-131). Inspect seal and replaced damaged or leaking seals and gaskets.	13.0
3	AXLES AND DRIVE TRAIN Place the vehicle on jack stands so that all wheels are clear of ground. With the differential control in the UNLOCK position (pulled out), by rotating at the wheels, check to see that each axle will turn independently of the other axles. Hold left wheel on No. 3 axle and have assistant turn the right in both directions. A series of uniform clicks will be heard. Repeat holding right wheel. Repeat for both wheels on axle No. 4. With the air reservoir pressure gage indicating 90-120 psi, place the differential control in the LOCK position (pushed in), rotate one wheel and check that all wheels rotate.	4.0
4	WINCH CABLES Unwind winch cables all the way and inspect for defects. Clean and lubricate as directed by LO 9-2320-258-12. Rewind evenly on drum.	2.8
5	OIL SYSTEM Follow lubrication chart. Check oil levels. Check oil filters for leaks and lines for possible breaks. Perform all the lubrication services specified in LO 9-2320-258-12 for annual, 12A, 6S and 3S services.	6.0
6	AIR CLEANER Replace filter element if when clean it does not go below 20 on restricter indicator.	1.2
7	ANTIFREEZE PROTECTION Service cooling system as outlined in TB 750-651.	1.6

Section V. TROUBLESHOOTING THE VEHICLE

2-16. Scope

a. This section contains troubleshooting information and tests for locating and correcting most of the troubles which may develop in the vehicle. Each malfunction for an individual component, unit or system is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

2-17. Troubleshooting

The tests and remedies provided in tables 2-4 through 2-12 are governed by the scope of the organizational level of maintenance. Tables 2-4 through 2-12, as listed below, include a list of malfunctions, test methods, and corrective actions for the truck tractor components and systems.

System	Table
1. Engine	2-4
2. Transmission	2-5
3. Axles and Propeller Shafts	2-6
4. Brakes and Air System	2-7
5. Power Steering	2-8
6. Frame Components	2-9
7. Body and Cab	2-10
8. Winch Hydraulic System	2-11
9. Non-Electrical Gages	2-12

Supplementary procedures and tests used in conjunction with troubleshooting various systems are included in the text of chapter 2.

Table 2-4. Troubleshooting

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

ENGINE

1. ENGINE CRANKS BUT FAILS TO START.

Step 1. Turn starter switch ON and turn auxiliary fuel pump switch ON. Visually inspect fuel lines and fittings from fuel tank to engine fuel pump. Inspect for leakage around canister gasket of strainer and filter.

    Tighten or replace leaking fittings, hoses or tubes as necessary.

Step 2. Visually inspect manual fuel shut-off valves at secondary fuel filter to assure it is fully open.

    Fully open fuel shut-off valve.

Step 3. Visually inspect freedom of action of fuel shut-off solenoid and linkage as fuel shut-off switch is actuated.

    Refer to Electrical Troubleshooting, table 2-22, for solenoid and engine stop (fuel shut-off) control circuit.

Step 4. Drain both fuel filter canisters into suitable containers (approx. 1 - 1½ pts. per canister) and inspect for water, dirt or other contamination.

    Service fuel strainer and filter as required (para 2-39).

Step 5. Inspect fuel lines and fittings for damage or kinks.

    Clean, replace or repair fuel lines as necessary (para 2-42).

2. ENGINE FAILS TO DEVELOP FULL POWER; EXHAUST STACKS MAY EMIT PUFFS OF SMOKE OR CONSIDERABLE BLACK SMOKE.

Step 1. Observe air restriction indicators as engine is accelerated from idle to 1500 - 2000 rpm. If indicator shows 20, the cleaner is restricted.

    Service air cleaners (refer to para 2-44).

Step 2. Check for full throttle travel.

    Adjust throttle control linkage (para 2-45).

Step 3. Refer to malfunction 1 above.

    Refer to corrective actions in 1 above.

Step 4. Check for winch PTO governor control limiting engine speed to 1800 - 1900 rpm. Disconnect electrical connector at winch PTO solenoid. If engine rpm is now normal, the electrical ciruit is defective.

    Refer to Electrical Troubleshooting, table 2-23, for winch PTO control.

Disconnect oil line from PTO solenoid valve to governor. With PTO switch off (indicator light out), start engine and check for discharge of oil from open oil line. If oil discharges, the valve is defective.

    Replace defective PTO solenoid valve (para 2-102).

Table 2-4. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 5. Remove exhaust stacks and inspect for damage or clogging. Check freedom of rain caps. Check freedom of rotation of exhaust turbochargers

Replace exhaust stacks or caps as necessary (para 2-47). Notify supporting maintenance if turbochargers do not rotate freely.

3. ENGINE STARTS, BUT MISFIRES OR DOES NOT RUN SMOOTHLY; EXHAUST MAY CONTAIN HEAVY BLUISH WHITE SMOKE.

Step 1. Refer to malfunction 1.

Refer to malfunction 1.

Step 2. Refer to malfunction 2, step 2.

Refer to malfunction 2, step 2.

Step 3. Check for improper use of ether injector during engine warm-up after cold start.

Refer to TM 9-2320-258-10 for proper use of cold start device.

4. EXCESSIVE FUEL USAGE.

Visually inspect fuel system for leakage or damage.

Make necessary repairs (para 2-42).

5. FUEL LEVEL INDICATOR DOES NOT INDICATE OR IS INACCURATE.

Refer to Electrical Troubleshooting, table 2-16.

Refer to Electrical Troubleshooting, table 2-16.

6. ENGINE CRANKS BUT DOES NOT START WHEN ETHER INJECTOR IS ACTUATED.

Step 1. Check for improper use of ether injector during cold start attempts.

Refer to TM 9-2320-258-10 for proper use of cold start kit.

Step 2. Remove ether bottle and shake to determine it contains ether or weigh bottle. Empty bottle weighs 17 ounces and a full bottle weighs 37 ounces. Remount bottle on valve and assure that it is fully screwed down. Hand tighten bottle.

Replace empty bottle (para 2-46).

Step 3. Observe linkage and solenoid for freedom of motion when injector control is actuated with starter switch in "run".

Repair or replace sticking linkage (para 2-46). Refer to Electrical Troubleshooting, table 2-14, for defective solenoid or control circuit.

Step 4. Check for defective injector valve. Refer to para 2-46.

Replace defective injector valve. Refer to para 2-46.

Step 5. Check for defective tubing.

If defective, notify supporting maintenance.

Step 6. Check for defective injector atomizers. Refer to para 2-46.

Clean or replace atomizers as required. Check proper positioning of atomizers at installation (para 2-46).

7. ENGINE OIL PRESSURE LOW AS INDICATED BY THE ENGINE OIL PRESSURE GAGE OR THE ENGINE/TRANSMISSION WARNING LIGHT.

Step 1. Check dipstick for oil level.

Fill to proper level (refer to LO 9-2320-258-10).

Step 2. Refer to Electrical Troubleshooting, table 2-16, and check for defective oil pressure indicator system or warning system.

Refer to Electrical Troubleshooting, table 2-16.

Step 3. Check for improper oil viscosity.

Drain and refill (refer to LO 9-2320-258-10).

8. HIGH ENGINE OIL TEMPERATURE INDICATED.

Step 1. Check dipstick for oil level and radiator sight glass for coolant level.

Fill to proper levels.

Step 2. Refer to Electrical Troubleshooting, table 2-16, and check for defective oil temperature indicator system.

Refer to Electrical Troubleshooting, table 2-16.

9. ENGINE OVERHEATS AS INDICATED BY THE ENGINE COOLANT TEMPERATURE INDICATOR.

Step 1. Check level on radiator sight gage. With engine stopped, if coolant can be seen on sight gage, coolant system is ready for operation.

Fill coolant system to proper level with liquid to suit climate conditions.

Start engine. Check for leakage at hose, lines, and fittings, to radiator, engine, and heat exchanger.

Tighten loose hose clamps. Replace leaking hoses, lines or fittings (para 2-53).

Step 2. Visually inspect drive-belts for condition and tightness. Inspect condition of fan blades. Start engine and observe that fan rotates.

Adjust drive-belts tension as required (para 2-52). Replace belts as required (para 2-52).

NOTE

Replace the four cooling fan drive-belts as a set. Replace fan if defective (para 2-51).

Step 3. Refer to Electrical Troubleshooting, table 2-16, and check for defective coolant temperature transmitter, indicator or electrical circuit.

Refer to Electrical Troubleshooting, table 2-16.

Step 4. Use a light placed in back of radiator to check for clogging of cooling air fins.

Clean as necessary with hose or steam clean. Use knife blade to straighten bent cooling fins.

Step 5. Remove and test thermostats (para 2-54).

Replace defective thermostats (para 2-54).

Table 2-4. Troubleshooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 6. Remove hoses and inspect for evidence of collapsing or separation of the inner ply of the hoses. Check for badly deteriorated hoses.

Replace hoses as required (para 2-53).

Step 7. Check for defective coolant pump.

Replace coolant pump.

10. ENGINE OVERCOOLS AS INDICATED BY ENGINE COOLANT TEMPERATURE INDICATOR.

Step 1. Refer to Electrical Troubleshooting, table 2-16, and check for defective coolant temperature transmitter, indicator or electrical circuit.

Refer to Electrical Troubleshooting, table 2-16.

Step 2. Remove and test thermostats (para 2-54). Inspect seals for damage or wear.

Replace defective thermostats (para 2-54). Install new seals.

Table 2-5. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

TRANSMISSION AND TRANSFER CASE ASSEMBLY

1. FOAMED OIL.

Step 1. Operate engine with transmission in stall to heat oil to 180°-200° on Transmission Oil Temperature indicator. Check dipstick level with engine at idle and transmission in Neutral to determine if oil level is too high.

Step 2. Visually inspect pump inlet line for damage or punctures or evidence of leakage.
Replace hose (para 2-99*d*).

Step 3. Improper oil viscosity.
Drain the transmission.

Step 4. Remove inlet hose and visually inspect O-ring seals for damage or collapse.
Replace O-rings (para 2-99*d*) transmission with correct type oil (LO 9-2320-258-12).

2. SLOW OR ERRATIC CLUTCH ENGAGEMENT.

Step 1. Check oil level on dipstick for low level.
Add oil to proper level (LO 9-2320-258-12).

Step 2. Drain transmission sump and visually inspect oil strainer screen for clogging.
Remove inspection cover and clean strainer screen (para 2-95).

Step 3. See malfunction 1. Check for foamed oil.
See corrective actions for malfunction 1 above.

Step 4. Refer to Electrical Troubleshooting, table 2-15, and check for defective range selector or range selector solenoid.
Refer to Electrical Troubleshooting, table 2-15.

3. LOW MAIN PRESSURE.

Step 1. Check oil level on dipstick for low level.
Add oil to proper level (LO 9-2320-258-12).

Step 2. Refer to malfunction 1. Check for foamed oil.
See corrective actions for malfunction 1 above.

Step 3. Refer to malfunction 1, step 2. Check for clogged oil strainer screen.
Remove inspection cover and clean strainer screen (para 2-95).

4. TRANSMISSION ASSEMBLY DOES NOT SHIFT INTO OR OUT OF LOCKUP AT THE CORRECT ENGINE RPM.

Visually inspect lock-up valve or pitot hoses and fittings for evidence of leaks or damage or leakage from seals. If hose appears worn, collapsed or damaged, remove and check for restrictions.
Tighten hose fittings as necessary or notify support personnel.

5. HIGH TRANSMISSION OIL TEMPERATURE.

Step 1. Check oil level on transmission dipstick for low level.
Add oil to proper level (LO 9-2320-258-12).

Step 2. Check for defective lube and scavenge pump. Remove the scavenge pump outlet line and the lube pump outlet line. Start the engine and, at idle, determine if oil flow is prevalent from both pump outlet ports. Do not run engine over 7 seconds. If a substantial oil flow cannot be seen, proceed to step 3.

Step 3. Check for defective lube and scavenge pump PTO drive. Remove the lube and scavenge pump. Cap all pump lines. Start the engine and at idle visually determine if the PTO output spline drive is rotating. Do not run engine over 7 seconds.
If the PTO output spline does not rotate, replace the PTO. If the PTO output spline does rotate, then the difficulty is with the lube and scavenge pump. Replace the lube and scavenge pump.

Step 4. Visually inspect all transmission oil lines and fittings for evidence of leaks or damage or leakage from seals. If lines or hoses appear worn, collapsed or damaged, remove and check for restrictions.
Tighten lines or hose fittings or notify support personnel.

Step 5. Refer to Electrical Troubleshooting, table 2-21. Check for defective retarder control circuit.
Refer to Electrical Troubleshooting, table 2-21.

6. SLOW TRANSMISSION CLUTCH ENGAGEMENT.

Step 1. Check oil level on transmission dipstick for low level.
Add oil to proper level LO 9-2320-258-12.

Step 2. Refer to Electrical Troubleshooting, table 2-15. Check for defective electrical range selector system or defective range solenoid.
Refer to Electrical Troubleshooting, table 2-15.

Step 3. Visually inspect all transmission oil lines and fittings for evidence of leaks or damage or leakage from seals particularly when the system is under pressure.
Tighten lines or hose fittings or notify support personnel.

Step 4. Remove and replace the transmission assembly.
Notify support personnel.

7. UNUSUALLY HOT TRANSFER CASE.

Step 1. Check oil level on transmission dipstick for low level.
Add oil to proper level (LO 9-2320-258-12).

Step 2. Check for defective lube and scavenge pump. Remove the scavenge pump outlet line and the lube pump outlet line. Start the engine and, at idle, determine if oil flow is prevalent from both pump output ports. Do not run the engine over 7 seconds. If a substantial oil flow cannot be seen, proceed to step 3.

Table 2-5. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 3. Check for defective lube and scavenge pump PTO drive. Remove the lube and scavenge pump. Cap all pump lines. Start the engine and, at idle, visually determine if the PTO output spline drive is rotating. Do not run the engine over 7 seconds.

If the PTO output spline does not rotate, replace the PTO. If the PTO output spline does rotate, then the difficulty is with the lube and scavenge pump. Replace the lube and scavenge pump.

Step 4. Visually inspect all transmission oil lines and fittings for evidence of leaks or damage or leakage from seals. If lines or hoses appear worn, collapsed or damaged, remove and check for restrictions.

Tighten lines or hose fittings or notify support personnel.

8. HYDRAULIC RETARDER DOES NOT OPERATE PROPERLY.

Refer to Electrical Troubleshooting, table 2-21. Check for defective electrical control circuit.

Refer to Electrical Troubleshooting, table 2-21.

9. LOSS OF DRIVE IN ONE OR MORE RANGES BUT NOT NECESSARILY ALL RANGES.

Step 1. Refer to Electrical Troubleshooting, table 2-15. Check for defective electrical range selector system.

Refer to Electrical Troubleshooting, table 2-15.

Step 2. Refer to Electrical Troubleshooting, table 2-15. Check for defective range solenoid.

Refer to Electrical Troubleshooting, table 2-15.

10. LOW ENGINE SPEED AT CONVERTER STALL.

Step 1. Check for cold transmission oil. Operate in 5th range converter stall until transmission oil temperature reaches 180°-200°.

Recheck stall rpm.

Step 2. Refer to Engine Troubleshooting, table 2-4. Check for low engine power output.

Refer to Engine Troubleshooting, table 2-4.

11. HIGH ENGINE SPEED AT CONVERTER STALL.

Step 1. Check transmission oil level on dipstick.

Add oil to proper level (LO 9-2320-258-12).

Step 2. Refer to malfunction 1. Check for foamed oil.

See corrective actions for malfunction 1.

12. LOSS OF POWER.

Step 1. Refer to malfunction 1. Check for foamed oil.

See corrective actions for malfunction 1.

Step 2. Check for overheating brake drums indicating dragging brakes.

Refer to Brake Troubleshooting, table 2-7.

Step 3. Observe transmission oil temperature indicator for overheat indicators indicating engaged retarder.

See corrective actions for malfunction 6 above.

13. HOT AND NOISY TRANSFER CASE DUE TO INSUFFICIENT LUBRICATION.

Step 1. Check oil level on transmission dipstick for low level.

Add oil to proper level (LO 9-2320-258-12).

Step 2. Check for defective lube and scavenge pump. Remove the scavenge pump outlet line and the lube pump outlet line. Start the engine and at idle determine if oil flow is prevalent from both pump outlet ports. Do not run engine over 7 seconds.

If a substantial oil flow cannot be seen, proceed to step 3.

Step 3. Check for defective lube and scavenge pump PTO drive. Remove the lube and scavenge pump. Cap all pump lines. Start the engine and at idle visually determine if the PTO output spline drive is rotating. Do not run the engine over 7 seconds.

If the PTO output spline does not rotate, replace the PTO. If the PTO output spline does rotate, then the difficulty is with the lube and scavenge pump. Replace the lube and scavenge pump.

Step 4. Visually inspect all transmission oil lines and fittings for evidence of leaks or damage or leakage from seals. If lines or hoses appear worn, collapsed or damaged, remove and check for restrictions.

Tighten lines or hose fitting or notify support personnel.

14. HOT TRANSFER CASE DUE TO EXCESSIVE LUBRICANT IN TRANSFER ASSEMBLY.

Step 1. Inspect hoses and fittings for leaks, damage or kinking. Check fittings for tightness. Check hoses for restrictions.

Tighten hoses and fittings. Replace as required.

Step 2. Check for defective lube and scavenge pump. Remove the scavenge pump outlet line and the lube pump outlet line. Start the engine and, at idle, determine if oil flow is prevalent from both pump outlet ports. Do not run engine over 7 seconds.

If a substantial oil flow cannot be seen, proceed to step 3.

Step 3. Check for defective lube and scavenge pump PTO drive. Remove the lube and scavenge pump. Cap all pump lines. Start the engine and, at idle, visually determine if the PTO output spline drive is rotating. Do not run the engine over 7 seconds.

If the PTO output spline does not rotate, replace the PTO. If the PTO output spline does rotate, then the difficulty is with the lube and scavenge pump. Replace the lube and scavenge pump.

15. RANGE SELECTION NOT POSSIBLE IN ONE OR ALL RANGES; SELECTOR HANDLE DOES NOT AGREE WITH RANGE SELECTED; TRANSMISSION DROPS OUT OF RANGE SELECTED.

Refer to Electrical Troubleshooting, table 2-15, and check for defective range selector or electrical circuit.

Refer to Electrical Troubleshooting, table 2-15.

Table 2-5. Troubleshooting - Continued

MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

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16. DOWN SHIFT INHIBITOR DOES NOT FUNCTION.

Step 1. Operate and observe vehicle and tachograph for lock-up action. Transmission should go into lock-up.

Refer to malfunction 4 for Transmission Troubleshooting or notify support personnel.

Step 2. Visually inspect lock-up valve to range selector oil line for evidence of damaged tubing, loose fittings or kinked hose. Disconnect at the lock-up valve and the shift selector to use air hose to check for clogging.

Tighten leaking fittings or replace tubing or hose as necessary (para 2-99).

Step 3. Disconnect hose at the shift selector and with a pressure gage (0-300 psi) on hose end, drive vehicle and observe gage for lock-up pressure, 180-200 psi. If pressure is normal, clutch is defective.

Replace shift selector assembly (para 2-97).

Table 2-6. Troubleshooting

MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

AXLES AND PROPELLER SHAFTS

1. EXCESSIVE STEERING EFFORT REQUIRED TO TURN STEERING WHEEL OR NOISY STEERING KNUCKLE (FRONT AXLES).

Step 1. Refer to Power Steering System Troubleshooting, table 2-8. Check for defective power steering hydraulic system or steering linkage.

Refer to Power Steering System Troubleshooting, table 2-8.

Step 2. Jack front of vehicle to get wheels clear of ground, disconnect drag links from idler arm at the steering arms and the steering cylinders from the tie rods. Move wheels from stop to stop to check for binding. If binding, lubricate knuckles. If binding persists, disconnect one end of tie rods and check for binding on each knuckle. Remove hub and drum assembly, brake shoes, and spindle assembly (para 2-108). Remove CV joint and shaft assembly. Inspect condition of lubrication and for damage to CV joint. Remove trunnion cap assemblies and inspect for excessive wear on caps or bushings (para 2-110). Check knuckle for proper adjustment of socket assemblies after reassembly (para 2-108*b* (11)).

Lubricate or replace components as required.

2. LOOSE STEERING KNUCKLE (FRONT AXLES).

Remove trunnion bearing caps and inspect for damage or wear. Perform adjustment (para 2-110).

Replace caps or bushings as required (para 2-110).

3. AXLE LUBRICANT LEAKING FROM CV BOOT (FRONT AXLES).

Step 1. Visually inspect area around CV boot for evidence of axle lube. Check level of lube in axle housing (LO 9-2320-258-12).

Replace axle shaft seal (para 2-108). Refill axle housing to correct level (LO 9-2320-258-12).

Step 2. Visually inspect axle housing vent hose for damage or clogging. Use air hose to check for clogging.

Replace nylon vent hose(s) as necessary (para 2-123).

4. LUBRICANT LEAKING FROM DIFFERENTIAL CARRIER TOP OR SIDE COVER PLATES OR INSPECTION COVER (ALL AXLES).

Check cover plate bolts for tightness. Check tightness of inspection cover plates and safety wire. Check for defective sealant.

Tighten bolts or notify support personnel to reseal.

5. AXLE LUBRICANT LEAKING FROM DRIVE FLANGE OR HUB (REAR AXLES).

Visually inspect axle housing vent hose for damage or clogging. Use air hose to check for clogging.

Replace vent hose(s) as necessary (para 2-123).

6. CONTINUOUS AXLE OR WHEEL NOISE (ALL AXLES).

Step 1. Check lube level in axle housing.

Fill axle housing to correct level (LO 9-2320-258-12).

Step 2. Check for overheating of wheel hub assembly. Assure that brake shoes are not dragging (refer to Brake Troubleshooting, Table 2-7). Jack wheel clear of ground. Use tanker bar to pry up under wheel to check for loose bearings. Any movement of wheel indicates loose bearings. With brakes released, turn wheel to check for overly tight bearings. Wheel should turn freely and smoothly. Remove hub and drum to check condition of bearings and lubricant if wheel continues to overheat after adjusting bearings.

Correct dragging brake (para 2-115), adjust bearings (para 2-130), front wheels (para 2-130), rear wheels, or remove, clean, repack or replace bearings as necessary.

REAR AXLES ONLY

7. CONTINUOUS AXLE OR WHEEL NOISE (REAR AXLES ONLY).

Visually inspect oil lube pump to differential carrier housing for damage. Remove and check tube for clogging. Check tightness of clamp on suction hose. Remove lube pump (para 2-113) and inspect pump drive coupling for wear and damage. Check for suction on pump while rotating shaft.

Tighten tube fittings and hose clamps. Replace components as required (para 2-113).

Table 2-6. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

8. DIFFERENTIAL CARRIER ASSEMBLY OVERHEATING (ALL AXLES).
   - Step 1. Check lube level in axle housing.
     - Fill to proper level (LO 9-2320-258-12).
   - Step 2. Refer to malfunction 7, above.
9. DIFFERENTIAL CARRIER ASSEMBLY MOUNTING BOLTS LOOSENING IN AXLE HOUSING.
   - Step 1. Check tightness of bolts around carrier mounting flange.
     - Tighten mounting bolts. Notify support personnel to retorque to requirements.
   - Step 2. Check tightness of yoke bolts at both universal joints.
     - Tighten bolts as necessary (para 2-105).
   - Step 3. Inspect propeller shaft and universal joints for evidence of damage or excessive wear and sufficient lubrication.
     - Replace worn or damaged components. (para 2-104), 2-105). Lubricate (LO 9-2320-258-12).
   - Step 4. Check to assure that the shaft is alined by the alining arrows and that universal joint lube fittings are in line.
     - Disassemble and aline as necessary (para 2-105).
   - Step 5. Disconnect propeller shaft from universal joints and remove from vehicle. Check freedom of motion of splines by moving shaft from the fully retracted to full extension. Shafts 1 and 4 should travel 5 inches; shafts 2 and 3 should travel 4½ inches. If excessive force is required to retract or extend shaft, or it does not reach full travel, separate shaft halves and inspect splines for wear, damage and lubrication.
     - Reassemble the shaft and lubricate or replace shaft assembly as required (para 2-106).
10. EXCESSIVE NOISE OR VIBRATION.
    - Refer to malfunction 9 above.
      - Refer to malfunction 9 above.

Table 2-7. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

BRAKES AND AIR SYSTEM

1. NO OR LOW AIR PRESSURE AS INDICATED ON RESERVOIR PRESSURE GAGE.
   - Step 1. Refer to para 2-122 and perform tests *a* through *c*.
     - Troubleshoot trailer (Ref. TM 9-2330-294-14).
   - Step 2. Check for leakage at the couplings. Check for damaged or missing gasket in coupling to trailer.
     - Replace gasket.
   - Step 3. Check for air exhausing through open or damaged air reservoir drain valve.
     - Close or replace drain valves as required.
   - Step 4. Visually inspect compressor drive belts for damage and proper tension.
     - Replace damaged belts and adjust belt tension (para 2-128*g*(4)).
   - Step 5. With engine operating at idle or with an external air source connected to the service fill coupling, perform leakage tests (para 2-122, test *w*).
     - Repair all leaks.
   - Step 6. Refer to para 2-122 and perform test *i* (1) for defective reservoir air delivery system.
     - Replace defective hose, air lines or check valves.
   - Step 7. Refer to para 2-122 and perform test *i* (1). Check for defective compressor or governor.
     - Adjust or replace governor or compressor as necessary (para 2-128).
2. EXCESSIVE RESERVOIR PRESSURE.
   - Step 1. Check position of governor shutoff valve.
     - Open valve.
   - Step 2. Refer to para 2-122 and perform test *i* (2). Check for defective shutoff valve or hose.
     - Replace defective hose or valve (para 2-123).
   - Step 3. Refer to para 2-122 and perform test *i* (2). Check for defective governor or governor adjustment.
     - Adjust governor (para 2-128*i*) or replace (para 2-128*b*, *h*).
3. EXCESSIVE PRESSURE BUILDUP TIME.
   - Step 1. Reference Test or Inspection in malfunction 1.
     - Reference corrective actions in malfunction 1.
   - Step 2. Refer to para 2-122 and perform test *i*. Check for defective compressor or governor.
     - Adjust or replace governor or compressor as necessary. (para 2-128 *b*, *h*, *i*).
4. FAIL-SAFE BRAKES WILL NOT RELEASE (ALL WHEELS).
   - Step 1. Observe reservoir pressure gage and check that low pressure warning light is out.
     - Refer to malfunction 1.
   - Step 2. Visually inspect intervehicular air hoses to trailer for proper connection.
     - Connect hoses properly.

Table 2-7. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 3. Visually inspect intervehicular hose shutoff valves.
Open valves.
Step 4. Refer to para 2-122 and perform test *d* and continue tests as nececessary until fault is located.
Repair damaged line(s) and/or replace faulty component(s).

5. FAIL-SAFE BRAKES WILL NOT RELEASE (TRAILER ONLY).
Step 1. Visually inspect intervehicular air hoses to trailer for proper connection.
Close shutoff valves and disconnect the hoses. Reconnect hoses properly and open shutoff valves.
Step 2. Visually inspect intervehicular hose shutoff valves.
Open shutoff valve.
Step 3. Refer to para 2-122 and perform test *d*. Check for defective trailer brake system.
Troubleshoot trailer.
Step 4. Refer to TM 9-2330-294-14 for trailer pressure checks. Check for trailer pressure below 65 psi.
Push in the trailer fill control valve on tractor dash panel.

6. FAIL-SAFE BRAKES WILL NOT RELEASE (ALL WHEELS ON TRACTOR REAR TANDEM).
Step 1. Refer to para 2-122 and perform test *d*. Check for defective fail-safe brake system.
Continue tests on tractor to isolate defective component.
Step 2. Refer to para 2-122 and perform test *j*. Check for defective fail-safe relay valve.
Replace defective relay valve (para 2-126).
Step 3. Refer to para 2-122 and perform test *v*. Check for defective parking/emergency brake control valve.
Replace defective parking/emergency brake control valve (para 2-124).

7. FAIL-SAFE BRAKES WILL NOT RELEASE (BOTH WHEELS OF ONE AXLE).
Visually inspect lines and hoses for damage, kinks or breaks. Cautiously loosen a line fitting at one of the brake chambers with parking brakes released and listen for escaping air; no air indicates a clogged line.
Replace clogged air line or hose assembly (para 2-123).

8. FAIL-SAFE BRAKES WILL NOT RELEASE (ONE OR MORE BUT NOT ALL WHEELS ON REAR TANDEM).
Step 1. Visually inspect air lines for kinks or damage. Manually cage brakes on affected wheel. If wheel becomes free, a clogged air line is indicated. Check for damaged or clogged air line from tee on axle to affected wheel or crossover line between two brake chambers on a wheel.
Replace damaged or clogged air line (para 2-123).
Step 2. Was vehicle parked after operating in snow, rain or mud during freezing weather? Check for brake shoes frozen to brake drum.
Apply hot air to drum to free brake shoes.
Step 3. Release brakes and check for leakage from fittings for fail-safe air chamber.
Tighten leaking fittings or replace leaking fail-safe assembly (para 2-120*b*).
Step 4. Manually cage fail-safe. If it will not cage, it is defective.
Replace defective fail-safe assembly (para 2-120*b*).
Step 5. Manually cage fail-safe and check lining to drum clearance. If no clearance exists, manually adjust brakes (para 2-115) until clearance is obtained, then remove hub and drum assembly (para 2-131). Visually inspect brake return springs. Disassemble and inspect actuators.
Step 6. Service, clean, replace or repair brake actuator parts as required (para 2-120*c*, *d*, *e*).

9. SERVICE BRAKES WILL NOT RELEASE.
Step 1. Check reservoir pressure gage in cab and operate engine to build up pressure to 90-120 psi.
Refer to malfunction 1 if pressure will not reach operating range.
Step 2. Visually check position of service brake hand control lever.
Return service brake hand control lever to the full OFF position.
Step 3. Visually check intervehicular hoses and shutoff valves. Service, emergency tags should correspond.
Connect hoses properly and open valves.
Step 4. Refer to para 2-122 and perform test *k*. Check for defective treadle valve.
Replace defective treadle valve (para 2-124*b*, *c*).
Step 5. Refer to para 2-122 and perform test *n*. Check for defective trailer service air relay valve.
Replace defective relay valve (para 2-126).
Step 6. Refer to para 2-122 and perform tests *l*, or *m*, for the tandem affected. Check for defective front or rear tandem service relay valve.
Replace defective relay valve (para 2-126).
Step 7. Refer to para 2-122 and perform test *p*. Check for defective trailer brake hand control valve.
Replace defective trailer brake hand control valve (para 2-124).

10. NO SERVICE BRAKES WHEN TREADLE PEDAL IS DEPRESSED.
Step 1. Visually inspect trailer service air hose and shutoff valve.
Connect hose and open shutoff valve.
Step 2. Refer to para 2-122 and perform test *k*. Check for defective treadle valve.
Replace defective treadle valve (para 2-124*b*, *c*).

Step 3. Refer to para 2-122 and perform test *q*. Check for defective two-way check valve No. 1.
Replace defective check valve (para 2-123).

Table 2-7. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

11. NO SERVICE BRAKES ON TRAILER *ONLY*, WHEN ACTUATED BY THE TREADLE VALVE.

Step 1. Visually inspect service air hose and shutoff valve.
Connect service air hose to trailer and open shutoff valve.

Step 2. Refer to para 2-122 and perform test *n*. Check for defective trailer service air relay valve.
Replace defective relay valve (para 2-126).

Step 3. Refer to para 2-122 and perform test *o*. Check for defective proportioning valve.
Replace defective proportioning valve (para 2-127).

Step 4. Refer to para 2-122 and perform test *s*. Check for defective two-way check valve No. 3.
Replace defective check valve (para 2-123).

Step 5. Check for defective trailer brake system.
Troubleshoot trailer. (Ref. TM 9-2330-294-14).

12. TRAILER SERVICE BRAKES DO NOT RESPOND WHEN USING REAR AUXILIARY AIR COUPLINGS.

Step 1. Visually inspect service air hose couplings and shutoff valves.
Connect hoses and open valves.

Step 2. Refer to para 2-122 and perform test *r*. Check for defective two-way check valve No. 2.
Replace defective check valve (para 2-127).

Step 3. Check for defective trailer service brake system.
Troubleshoot trailer. (Ref. TM 9-2330-294-14).

13. SERVICE BRAKES DO NOT RESPOND ON TRAILER WHEN APPLIED WITH THE TRAILER BRAKE HAND CONTROL.

Step 1. Refer to para 2-122 and perform test *p*. Check for defective trailer brake hand control valve.
Replace defective control valve (para 2-124).

Step 2. Refer to para 2-122 and perform test *r* or test *s*. Check for defective two-way check valve No. 2 or No. 3 depending on service coupling in use.
Replace defective check valve (para 2-123).

Step 3. Check for defective trailer brake system.
Troubleshoot trailer. (Ref. TM 9-2330-294-14).

14. FAIL-SAFE BRAKES DO NOT APPLY (TRACTOR REAR TANDEM AND/OR TRAILER).

Step 1. Visually inspect vent tube on parking/emergency control valve for damage, kinks or clogging.
Replace damaged, kinked or clogged vent tube (para 2-123).

Step 2. Refer to para 2-122 and perform test *v*. Check for defective parking/emergency control or trailer emergency fill valve.
Replace defective control valve or fill valve (para 2-124).

Step 3. Check for damaged, kinked or clogged air line between parking/emergency brake control valve and fail-safe relay valve or between two-way check valve No. 5 and emergency air couplings.
Replace damaged or clogged air lines (para 2-123).

Step 4. Refer to para 2-122 and perform test *j*. Check for defective fail-safe relay valve.
Replace defective fail-safe relay valve (para 2-126).

15. WEAK OR SLOW RESPONDING SERVICE BRAKES (ALL WHEELS, TRACTOR AND/OR TRAILER).

Step 1. Refer to malfunction 1 for test method. Check for low reservoir air pressure.
Refer to malfunction 1 for corrective action.

Step 2. Refer to para 2-122 and perform test *k*. Check for defective treadle valve.
Replace defective treadle valve (para 2-124*b*, *c*).

Step 3. Refer to para 2-122 and perform test *q*. Check for defective two-way check valve No. 1.
Replace defective check valve (para 2-123).

Step 4. Refer to para 2-122 and perform test *o*. Check for defective proportioning valve.
Replace defective proportioning valve and adjust new valve (para 2-127).

Step 5. Inspect the signal air lines from the treadle valve to front tandem and proportioning valves for damage, kinks, and clogging.
Replace damaged, kinked or clogged air line (para 2-123).

Step 6. Inspect signal air line from proportioning valve to trailer service and rear service relay valves for evidence of damage, kinks or clogging.
Replace damaged, kinked or clogged air lines (para 2-123).

16. WEAK OR SLOW RESPONDING SERVICE BRAKES (TRAILER WHEELS ONLY).

Step 1. Inspect the signal air line from proportioning valve to trailer relay valve for damage, kinks or clogging.
Replace damaged, kinked or clogged air line.

Step 2. Inspect trailer service air hoses and shutoff valves for damage or clogging.
Replace damaged or clogged hose or valve.

Step 3. Refer to para 2-122 and perform test *n*. Check for defective trailer service air relay valve.
Replace defective relay valve (para 2-126).

Step 4. Refer to para 2-122 and perform test *s*. Check for defective two-way check valve No. 3 (check valve No. 2 if rear auxiliary coupling used).
Replace defective check valve (para 2-123).

Table 2-7. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 5. Depress treadle pedal and check for leakage. Refer to para 2-122 test *w*. Check for relay valve or fittings leaking.
Tighten fittings and valve nuts or replace valve as necessary.

Step 6. Check for defective trailer service brake system.
Troubleshoot trailer. (Ref TM 9-2330-294-14).

17. WEAK OR SLOW ACTING SERVICE BRAKES (FRONT TANDEM WHEELS).

Step 1. Refer to para 2-122 and perform test *l*. Check for defective front service relay valve.
Replace defective relay valve (para 2-126).

Step 2. Inspect air line from two-way check valve to front service relay valve for damage, kinks or clogging.
Replace damaged, kinked or clogged air line (para 2-123).

Step 4. Check for damaged, kinked or clogged signal air line from treadle valve to front service relay valve.
Replace damaged, kinked or clogged air line (para 2-123).

20. UNEVEN OR ERRATIC SERVICE BRAKES (REAR TANDEM AND TRAILER WHEELS).

Step 1. Refer to para 2-122 and perform test *o*. Check for defective proportioning valve.
Replace and adjust new proportioning valve (para 2-127).

Step 2. Depress treadle valve pedal and check proportioning valve and fittings for leaks. Refer to para 2-122, test *w*.
Tighten fittings or replace proportioning valve as required.

Step 3. Check for damaged, kinked or clogged air line from two-way check valve No. 1 to proportioning valve, and from proportioning valve to rear service relay valve.
Replace damaged, kinked or clogged air lines (para 2-123).

21. UNEVEN OR ERRATIC SERVICE BRAKES (TRAILER WHEELS ONLY).

Step 1. Refer to para 2-122 and perform test *n*. Check for defective trailer service air relay valve.
Replace defective relay valve (para 2-126).

Step 2. Refer to para 2-122 and perform test *s* (or *r*). Check for defective two-way check valve No. 3 (check valve No. 2 if rear auxiliary coupling used).
Replace defective check valve (para 2-123).

Step 3. Depress treadle valve pedal and check trailer service air relay valve, fittings and air signal lines to proportioning valve and service couplings for leakage.
Tighten fittings or relay valve nuts; repair or replace valve or air lines as necessary.

Step 4. Check for damaged, kinked or clogged air signal line between proportioning valve and trailer service air relay valve or between relay valve and service air coupling.
Replace damaged, kinked or clogged air line (para 2-123).

Step 5. Check for defective trailer brake service system.
Troubleshoot trailer. (Ref TM 9-2330-294-14).

22. UNEVEN OR ERRATIC SERVICE BRAKES (FRONT TANDEM WHEELS ONLY).

Step 1. Refer to para 2-122 and perform test *l*. Check for defective front service relay valve.
Replace defective relay valve (para 2-126).

Step 2. Inspect signal air line to relay valve for damage, kinks and clogging.
Replace damaged, kinked or clogged air line (para 2-123).

23. UNEVEN OR ERRATIC SERVICE BRAKES (REAR TANDEM WHEELS ONLY).

Step 1. Refer to para 2-122 and perform test *m*. Check for defective rear service relay valve.
Replace defective relay valve (para 2-126).

Step 2. Refer to para 2-122 and perform test *o*. Check for defective proportioning valve.
Replace defective proportioning valve (para 2-127*b*, *c*).

Step 3. Depress treadle valve pedal and check for leakage in rear service relay valve, proportioning valve, fittings or interconnecting air signal line. Refer to para 2-122, test *w*.
Tighten leaking fittings or relay valve nuts; repair or replace components as necessary.

Step 4. Check for damaged, kinked or clogged signal air line to rear service relay valve.
Replace damaged, kinked or clogged air line (para 2-123).

24. UNEVEN OR ERRATIC SERVICE BRAKES (ONE OR MORE WHEELS).

Step 1. Depress treadle pedal and perform leakage checks. Check for leak in hose or air line from relay valve to affected wheel. (Refer to para 2-122, test *w*.
Tighten loose fittings, repair or replace hoses or air lines as necessary.

Step 2. Visually inspect for damaged, kinked or clogged air line between relay valve and brake chamber on affected wheel. Loosen line fitting at the brake chambers and partially depress pedal. Listen for air exhausting from air line; no air indicates clogged air line.
Replace damaged, kinked or clogged air line (para 2-123).

Step 3.. Check for excessive drum to lining clearance (para 2-115).
Manually adjust brake (para 2-115) and schedule for maintenance when situation permits. If manual adjustments do not correct brake, inspect, repair or replace automatic adjusters (para 2-119*e*, 2-120*e*).

Step 4. Depress treadle valve pedal and check for leakage around fail-safe ring clamp indicating loose clamp or punctured diaphragm. (Refer to para 2-122, test *w*).
Tighten ring clamp or replace diaphragm as required.

Step 5. Remove hub and drum assembly to inspect plunger and adjuster mechanism and brake return springs (para 2-119), 2-120).
Clean, repair, and assemble plunger and adjuster assembly as required (para 2-119, 2-120). Replace or reseat brake return springs as required (para 2-119*a*, 2-120*a*).

Table 2-7. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

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25. NO SERVICE BRAKES AT ONE OR MORE WHEELS BUT NOT ALL.

Step 1. Inspect air line for damage, kinks or clogging. Disconnect air line at brake air chamber and depress pedal. No air exhausting from line indicates clogged line.
    Replace damaged, kinked or clogged air lines (para 2-123).

Step 2. Reconnect air line. Fully depress pedal and check for leakage around fail-safe air chamber ring clamp and air line fittings (para 2-122*w*). Check tightness of ring clamp bolt and fittings. If leakage continues around ring clamp, the fail-safe diaphragm is defective.
    Replace defective fail-safe diaphragm (para 2-119*c*, 2-120*c*).

Step 3. Check drum to lining clearance (para 2-115).
    Manually adjust brake (para 2-115); if this fails, inspect, repair or replace automatic adjusters (para 2-119*e*, 2-120*e*).

Step 4. Manually cage fail-safe units (para 2-116), and remove, inspect and clean air chamber and wedge assembly. Remove hub and drum assembly (para 2-130, 2-121) and inspect mechanism. Assure brake shoe return springs are properly engaged. Inspect and service plungers.
    Clean, repair or replace brake mechanism parts as required (para 2-119, 2-120).

26. BRAKES OVERHEAT.

Step 1. Assure that reservoir pressure is at 90-120 psi operating range. Observe reservoir pressure gage.
    Refer to malfunction 1.

Step 2. Refer to para 2-122 and perform test *j*, *l* or *m*. Check for defective front or rear service relay valve.
    Replace defective service relay valve (para 2-126).

Step 3. Pull hub and drum assembly (para 2-130, 2-131) and inspect brake mechanism. Apply brakes and observe shoe movement. Shoes should expand and return smoothly.
    Replace broken or weak return springs. Clean, service, and assemble brake mechanism if action is not smooth (para 2-119, 2-120).

Step 4. Check for too little drum to lining clearance (para 2-115).
    Adjust brakes (para 2-115). If adjusting fails, inspect, repair or replace automatic adjusters (para 2-119*e*, 2-120*e*).

Step 5. Remove hub and drum assembly and inspect wheel bearings for damage.
    Adjust or replace wheel bearings (para 2-130, 2-131).

27. AIR HORN DOES NOT OPERATE.

Step 1. Observe low pressure warning light. Light goes off at 54-66 psi.
    Operate engine until light goes off.

Step 2. Visually inspect auxiliary system shutoff valve at emergency tank (right side).
    Open shutoff valve.

Step 3. Visually inspect air line for damage, kinks or clogging.
    Replace damaged, kinked or clogged air line (para 2-123).

Step 4. Check for defective electrical solenoid. Refer to Electrical Troubleshooting (table 2-24).

28. NO SERVICE BRAKE RESPONSE WHEN BEING TOWED BY ANOTHER VEHICLE.

Step 1. Visually inspect brake hose connection at front service coupling.
    Connect air hose to coupling.

Step 2. Visually inspect shutoff valve on towing vehicle.
    Open shutoff valve.

Step 3. Inspect signal air line to coupling for damage, kinks or clogging.
    Replace damaged, kinked or clogged air line (para 2-123).

Step 4. Refer to para 2-122 and perform test *q*. Check for defective two-way check valve No. 1.
    Replace defective check valve (para 2-122).

Step 5. Inspect supply hose from towing vehicle connection and shutoff valve position.
    Connect supply hose to left front coupling and open shutoff valve.

29. VEHICLE RESERVOIRS WILL NOT PRESSURIZE THROUGH AUXILIARY FILL COUPLING.

Step 1. Visually inspect shutoff valve on towing vehicle.
    Open shutoff valve.

Step 2. Check for damaged, kinked or clogged air line between coupling and right reservoir.
    Replace damaged, kinked or clogged air line (para 2-123).

Step 3. Visually inspect auxiliary fill coupling shutoff valve located on left front bumper near coupling.
    Open shutoff valve.

30. GRABBING BRAKES WHEN USING TREADLE VALVE PEDAL (ALL WHEELS, TRACTOR AND TRAILER).

Step 1. Refer to para 2-122 and perform test *k*. Check for defective treadle valve.
    Replace defective treadle valve (para 2-124*b*, *c*).

Step 2. Refer to para 2-122 and perform test *q*. Check for defective two-way check valve No. 1.
    Replace defective check valve (para 2-122).

Step 3. For rear tandem and trailer only, refer to para 2-122 and perform test *o*. Check for defective proportioning valve.
    Replace defective proportioning valve (para 2-127).

Step 4. For trailer wheels only, refer to para 2-122 and perform test *n*. Check for defective trailer service air relay valve.
    Replace defective relay valve (para 2-126).

Table 2-7. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 5. Refer to para 2-122 and perform test *s* and *r*. Check for defective two-way check valve No. 3 or No. 2.
Replace defective check valve (para 2-122).
Step 6. Check for defective trailer service brake system.
Troubleshoot trailer. (Ref TM 9-2330-294-14).
Step 7. For tractor rear tandem only, refer to para 2-122 and perform test *m*. Check for defective rear service relay valve.
Replace defective relay valve (para 2-126).
Step 8. For tractor front tandem only, refer to para 2-122 and perform test *l*. Check for defective front service relay valve.
Replace defective relay valve (para 2-126).

31. GRABBING BRAKES WHEN APPLIED BY TRAILER *ONLY* HAND CONTROL.
Step 1. Refer to para 2-122 and perform test *f*. Check for defective trailer brake hand control valve.
Replace defective hand control valve (para 2-124).
Step 2. For trailer wheels only, refer to para 2-122 and perform test *r* and *s*. Check for defective two-way check valve Nos. 2 or 3.
Replace defective check valve (para 2-123).

32. TRACTOR BRAKES ACTUATE BY TRAILER BRAKE HAND CONTROL VALVE.
Refer to para 2-122 and perform test *r*. Check for defective two-way check valve No. 2.
Replace defective check valve (para 2-127).

33. DEFECTIVE INTERTANDEM DIFFERENTIAL LOCKOUT ACTION.
Step 1. Visually inspect auxiliary system shutoff valve at front of right supply tank.
Open shutoff valve.
Step 2. Check for defective intertandem differential control value or pressure supply line to valve. Push control knob in and check pressure at TP 9 (fig. 2-185). Pressure should be within 5 psi of reservoir pressure. Pull switch out; pressure at TP 9 should be 0 psi.
Replace defective control valve or air line (para 2-124 or 2-123*d*).
Step 3. Inspect for damaged, kinked or clogged air line to lockout actuator. Dissconnect air line at actuator and actuate valve to check for exhausting air. No air indicates clogged air line.
Replace damaged, kinked or clogged air line (para 2-123*d*).

34. STOPLIGHTS DO NOT OPERATE; BRAKES FUNCTION NORMALLY.
Step 1. Refer to para 2-122 and perform test *t*. Check for defective two-way check valve No. 4.
Replace defective check valve (para 2-124).
Step 2. Refer to Electrical Troubleshooting, table 2-26. Check for defective electrical circuit.
Refer to Electrical Troubleshooting, table 2-26.

35. RESERVOIR PRESSURE GAGE DOES NOT OPERATE OR IS NOT ACCURATE; AIR SYSTEM OPERATES NORMALLY.
With system fully pressurized, depress the service brake treadle and observe front brake pressure gage. Reservoir pressure gage should be within 5 psi of front pressure gage.
Replace defective gage (para 2-124).

36. REAR BRAKE PRESSURE GAGE DOES NOT INDICATE OR IS NOT ACCURATE; BRAKES OPERATE NORMALLY.
Step 1. Disconnect air line from pressure gage to rear service relay valve. Depress treadle valve pedal and check for exhausing air at line. No air indicates defective air line.
Repair or replace air line (para 2-123).
Step 2. With air line reconnected to gage, depress the treadle valve pedal fully; note indication on gage and check pressure at TP 11 (fig. 2-185). If the two pressures are not within 10 psi of each other, gage is defective.
Replace defective gage (para 2-124).

37. FRONT BRAKE PRESSURE GAGE DOES NOT INDICATE OR IS NOT ACCURATE; BRAKE OPERATES NORMALLY.
Step 1. Disconnect air line from treadle valve at gage and depress the treadle pedal. Listen for air exhausting from air line. No air exhausting indicates defective air line.
Replace defective air line (para 2-124).
Step 2. Reconnect air line. Depress treadle pedal; note pressure indicated on gage and check the pressure at TP 10 (fig. 2-185). If pressures are not within 10 psi of each other, the gage is defective.
Replace defective gage (para 2-124).

38. SEVERE PRESSURE DROP WHEN VEHICLE BRAKE TREADLE IS APPLIED.
Step 1. Visually inspect for broken service brake line.
Replace tubing (para 2-123).
Step 2. Check for defective service brake diaphragm.
See malfunction 24, step 4.
Step 3. Check for defective 2-way check valve No. 1, 2, 3 or 4.
See para 2-122*q*, *r*, *s* and *t*.

39. SEVERE PRESSURE DROP WHEN TRAILER BRAKE AND CONTROL VALVE APPLIED.
Step 1. Check for defective trailer brake system.
See TM 9-2330-294-14.
Step 2. Check for defective service brake diaphragm.
See malfunction 24, step 4.
Step 3. Check for defective 2-way check valve No. 1, 2, 3 or 4.
See para 2-122*q*, *r*, *s* and *t*.

Table 2-8. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

POWER STEERING SYSTEM

1. HARD STEERING (MAIN AND/OR AUXILIARY).

Step 1. Check main power steering pump drive belt tension.

If loose, adjust belt tension (para 2-139*c*).

Step 2. Observe level on hydraulic reservoir sight gage.

Fill reservoir to proper level on sight gage (refer to LO 9-2320-258-12).

Step 3. Observe appearance of oil in reservoir sight gage. If oil is light or cream color and above operating level, it is aerated.

Inspect suction line to main and auxiliary pumps for evidence of leakage and loose fittings. Check oil line fittings at both pumps for evidence of leakage and tight connections.

Step 4. Visually inspect position of hydraulic filter indicator. Check for clogged filter in hydraulic reservoir, reservoir filler vent cap or filler screen clogged.

Remove filler cap and check for contamination in filler screen and filler cap. Clean both of any dirt or contamination. Service the hydraulic filter (refer to LO 9-2320-258-12).

Step 5. Check the relief pressure on the integral flow control valve on the main power steering pump.

If pressure is below 900 psi, adjust to 950 ± 50 psi.

Step 6. Park vehicle on a dry hard surface (cement) and perform steering effort tests to check for binding in overall steering system.

a. With engine running at idle, use a spring scale hooked to end of one steering wheel spoke to pull at a right angle to spoke. Pull on scale with an even force necessary to keep steering wheel turning at a steady speed and note spring scale reading. A maximum of 9 pounds force should be required to turn steering wheel.

b. With front of vehicle on jacks so that all 4 front wheels are clear of ground and with the engine stopped, repeat steering effort given in step 6*a* above. Maximum effort allowable to turn steering wheel is 35 pounds.

c. If force required in step 6*a* exceeds 9 pounds, but force required in step 6*b* is 35 pounds or less, malfunction is in power steering hydraulic pressure system.

Refer to corrective action, step 11 through step 13 and continue troubleshooting.

d. If force required in step 6*a* exceeds 9 pounds, and/or force required in step 6*b* exceeds 35 pounds, malfunction is in mechanical linkage system.

Refer to corrective action, step 7 through step 10, and continue troubleshooting or notify support personnel.

Step 7. Visually inspect linkage for obvious wear or damage or lack of lubrication. Have assistant start engine and swing wheels through turns in each direction. Observe steering linkage for looseness or unseating of joints. Listen for snapping or popping sounds as wheels change directions to indicate loose or worn joints. Observe clamps clamping power steering cylinders to tie rods for motion during steer. Observe chamber end of power steering cylinders for excessive end motion on anchor balls during steer.

Lubricate steering linkage (refer to LO 9-2320-258-12). Tighten loose linkage joints or notify support personnel.

Step 8. Disconnect steering linkage from steering arm. Observe motion of arm and note the steering wheel effort as steering arm is moved from stop to stop. Motion of steering arm should be smooth and even; effort required on steering wheel should be smooth and even. A light drag should be felt as steering wheel is turned. Make this check without engine running.

Check lubrication in steering gear assembly (refer to LO 9-2320-258-12). Check condition of grease on steering coupling. Clean and regrease if contaminated (refer to LO 9-2320-258-12). If steering column and gear assembly are not rough, binding or require excessive effort to turn, omit step 8 and refer to step 9.

Step 9. With the steering column disconnected from steering gear shaft, check effort required to turn steering gear shaft by hand. Shaft should turn from stop to stop with only a moderate hand effort required to rotate shaft. Drag on shaft, which is normal, should remain constant. Make this check without engine running.

Replace steering gear assembly.

Step 10. Check lubrication in idler arm spindle and bearing. Check for loose bracket mounting bolts and for loose idler arm on spindle allowing excessive end play.

Lubricate idler arm (refer to LO 9-2350-258-12), or notify support personnel.

Step 11. Check for defective main powr steering pump. Install gage at PT 1 (fig. 2-216). Start engine and operate at 1500 rpm. Perform hard full steers in both directions. Pressure must not drop below 300 psi at any time.

If pressure drops below 300 psi, remove and replace the main power steering pump (para 2-139).

Step 12. Check for defective main power steering hydraulic control system. Install gage at pressure tap (PT) No. 2 (refer to fig. 2-216). Position a shim ⅜-1 inch thick between right No. 1 wheel stop and axle striking point and turn wheels to a full right steer to contact shim and hold it in place. Stop engine and disconnect 2 power steering lines at each cylinder. Plug open lines to system with 1 1/16-12 UNF pipe plugs. Restart engine and operate at 1000 rpm. Observe gages while steering wheel is turned in direction of a right turn to open steer valve. Pressure gage should indicate between 900 and 1000 psi.

a. If pressure gage indicates less than 900 psi, integral relief-flow control valve is defective.

Replace main power steering pump (para 2-139).

b. If gage at PT No. 2 indicates less than 900 psi, stop engine and connect gage to PT No. 1 and repeat test. If gage at PT No. 2 continues to indicate less than 900 psi and pressure at PT 1 indicates 900 to 1000 psi, transfer valve is defective or line between transfer valve is damaged or clogged. If both gages at PT 1 and PT 2 indicate less than 900 psi, check valve is defective or oil line between check valve and transfer valve is damaged, kinked or clogged.

Inspect oil line between transfer valve and steering gear control valve for damage, kinks, or clogging and replace if necessary (para 2-141). If line is not damaged, replace transfer valve (para 2-142). Inspect oil line between the check valve for damage, kinks or clogging and replace if necessary (para 2-141). If no damage is found in oil line, remove check valve and inspect it for clogging or sticking. Replace valve if necessary (para 2-142*d*).

Table 2-8. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

c. Reconnect hoses to steer cylinder on No. 1 axle and repeat test while observing pressure at PT 2. If pressure indicated is less than 900 psi, steer cylinder on axle No. 1 is defective.
Notify support personnel to replace steering cylinder.

d. Reconnect hoses to steer cylinder on No. 2 axle and repeat test. If pressure indicated at PT 2 is less than 900 psi, the steer cylinder on axle No. 2 is defective.

NOTE

Remove shim at wheel stop.

Notify support personnel to replace the steering cylinder.

Step 13. Install a pressure gage at PT No. 3 (fig. 2-216) and para 2-141*c*). Start engine and operate at 1500 rpm. Observe gage and perform hard full steers in both directions and hold momentarily against each axle stop. Pressure should not exceed 300 psi.
Inspect return line from steering gear control valve to reservoir for damage, kinks or clogging. Replace if necessary (para 2-141).

Step 14. Check for low tire pressures.
Inflate tires to proper pressure (para 2-129).

2. THE AUXILIARY POWER STEERING WARNING LIGHT STAYS ON AT SPEEDS HIGHER THAN 4 MPH.
OR
STEERING IS HARD AT SPEEDS GREATER THAN 4 MPH WHEN OPERATING WITH A DEFECTIVE MAIN POWER STEERING SYSTEM.
OR
NO STEERING IS AVAILABLE WHEN VEHICLE IS BEING TOWED AT SPEEDS GREATER THAN 4 MPH.

Step 1. Check for defective warning light or electrical circuit.
Refer to the Electrical Troubleshooting, table 2-17.

Step 2. Check for defective auxiliary power steering pump. Place vehicle on jack stands. Disconnect main power steering pump lines. Install pressure gages at pressure taps Nos. 2 and 4 (fig. 2-216 and para 2-141*c*). Turn wheels full right against wheel stops and disconnect power steering cylinder 4 unions along left frame rail. Plug hydraulic lines.

NOTE

Inspect to be sure that all wheels are clear of the jack stands.

Start engine, place transmission in fifth range and adjust engine speed to indicate 8 to 10 mph on the speedometer. Open steering valve by turning wheel to right and observe gages and warning light. Gages should indicate 900-1000 psi and warning light should go out.

a. If pressure at PT 4 is greater than 300 psi and warning light does not go out, pressure switch is defective.
Replace pressure switch (para 2-142*c*).

b. If pressure at PT 4 is 300 psi or less, auxiliary power steering pump is defective.
Visually inspect suction line from reservoir to auxiliary pump for bent or damaged tubes or kinks in hose. Assure that lines to auxiliary pump are properly connected. Check for leakage at fittings, tubes, hoses, and valves. If no damage or leakage is found, remove auxiliary pump and inspect drive coupling for damage (para 2-140). If drive coupling is not damaged, replace auxiliary pump.

c. If pressure at PT No. 4 is 900-1000 psi and pressure at PT No. 2 is less than 850 psi, transfer valve is defective.
Replace transfer valve (para 2-142*b*).

d. If pressure at both PT No. 2 and PT No. 4 are less than 900 psi and the warning light goes off, overload relief-flow control valve is defective.

NOTE

Reconnect power steering cylinder hoses.

Replace overload relief-flow control valve (para 2-142).

3. VEHICLE WANDERS OR LEADS TO ONE SIDE.

NOTE

Side slope or high crowned roads may be the cause. Check on level uncrowned surface.

Step 1. Check tire pressures.
Inflate tires to proper pressure (para 2-129).

Step 2. Cautiously feel brake drums. An excessively hot drum indicates a dragging brake.
Refer to Brake Troubleshooting, table 2-7.

Step 3. Cautiously feel the wheel hubs. An excessively hot hub indicates a defective or improperly adjusted wheel bearing.
Repair, replace or adjust as necessary (refer to para 2-130, 2-131).

Step 4. Inspect steering coupling column swivel for lubrication and check the coupling adjustment.
Lubricate coupling (refer to LO 9-2320-258-12). Adjust the coupling (para 2-134).

Step 5. Check taper stud adjustment for overtightness in cam groove.
Adjust stud in cam groove (para 2-136).

Step 6. Check for steering gear control valve out of adjustment or sticking. Place front of vehicle on jack stands. With engine at idle, accelerate to 1500-2000 rpm without holding steering wheel. Turn wheels off center and repeat acceleration. Wheels should not move right or left.
Replace steering gear assembly (para 2-137) or notify support personnel.

Table 2-8. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 7. Check for insufficient lubrication in steering linkage, loose linkage or damaged linkage. Steering; idler arm mounting bolts loose; steering gear mounting bolts or mounting bracket loose.
Service steering linkage (refer to LO 9-2320-258-12). Tighten loose linkage joints or notify support personel.

4. LOST MOTION OR EXCESSIVE BACKLASH OF STEERING WHEEL.

Step 1. Using a piece of stiff wire or weld rod taped to instrument panel with end of wire near rim of wheel to serve as a pointer, mark center position of steering wheel. Turn wheel to each side of center and mark at pointer on each side. Measure distance from center mark to each backlash mark by measuring around circumference of steering wheel.
a. Maximum backlash permitted with engine running is 1-¾ inches to right and 1-¾ inches to left.
b. Maximum backlash permitted without engine running is 9-½ inches to right and 9-½ inches to left. If protractor is used, maximum angle will be 10° to right and 10° to left with engine running; and 55° to left with engine stopped.

Step 2. Refer to malfunction 1, step 6.
Refer to corrective action for step 6, and/or notify support personnel.

Step 3. Check for loose steering column swivel coupling clamp.
Check clamp bolt. Tighten if necessary.

Step 4. Check for loose steering wheel on steering column shaft.
Check tightness of nut holding wheel to column shaft. Tighten if necessary (para 2-135).

Step 5. Check for excessive backlash of stud in cam groove of steering gear.
Perform the stud in cam groove adjustment (para 2-136). If this fails, replace steering gear assembly or notify support personnel for stud roller bearing adjustment.

5. TEMPORARY INCREASE IN EFFORT WHEN TURNING STEERING WHEEL LEFT OR RIGHT.

Step 1. Check oil level on reservoir sight gage.
Fill reservoir to operating level.

Step 2. Check for air trapped in system.
Run engine at 1000 rpm while moving steering wheel from stop to stop to expel the air.

Step 3. Check for insufficient lubrication in steering linkage, loose linkage or damaged linkage. Steering; idler arm mounting bolts loose; steering gear mounting bolts or mounting bracket loose.
Service steering linkage (refer to LO 9-2320-258-12). Tighten loose linkage joints or notify support personnel.

Step 4. Refer to malfunction 1, Test or Inspection, step 11 through step 13. Check for low power steering pump output or system pressure.
Refer to malfunction 1, corrective action, step 11 through step 13.

Step 5. Refer to malfunction 1, Test or Inspection, step 5 through step 9. Check for binding in steering linkage.
Refer to malfunction 1, Test or Inspection, step 5 through step 9.

6. VEHICLE DOES NOT FULL STEER FROM STOP TO STOP.

Step 1. Check for bent, damaged or loose steer linkage, socket, or loose steer cylinder rod clamp on tie-rod. Refer to Test or Inspection 1, step 6. At full steer in either direction, the wheel stops should be ⅛ inch away from striking points on both axles.
Refer to malfunction 1, corrective action, step 6. If a steer cylinder rod clamp is loose or indicates that it has slipped, notify support personnel.

Step 2. Check for defective steering gear. Disconnect drag link at steering arm. Observe steering arm as the steering wheel is turned from stop to stop. The steering wheel should turn 4.3 turns as steering arm moves through 80-84 degrees. Check that index mark on steering arm is alined with index mark on end of steering gear output shaft.
Aline index mark on steering arm and steering gear shaft if necessary (fig. 2). Replace steering gear if steering wheel does not turn 4.3 turns (para 2-137). Reconnect drag link to steering arm.

Step 3. Check for defective power steering cylinder or steering knuckle. With the front of vehicle up on jack stands, disconnect reach rod to No. 1 axle at the idler arm and disconnect the hydraulic hoses to No. 1 steering cylinder. Plug open lines. Start engine and operate at idle. Observe axle No. 2 as attempts are made to steer from stop to stop.* If wheels do not turn through full travel, stop engine and unclamp the cylinder rod end from tie-rod. Start engine and operate at idle. Measure stroke of piston rod as it is moved from fully extended to fully retracted.

NOTE

Rod motion will be rapid with end free of load.

Full stroke of rod end should be 11 inches.

a. If full steer cylinder stroke is not 11 inches, cylinder is defective.
Notify support personnel to replace power steering cylinder.

b. If the steering cylinder is normal, a steering knuckle or knuckles are defective.
Disassemble steering knuckle(s) and inspect CV joints, trunnions and knuckle housings. Repair or replace as necessary (para 2-108).

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*If wheels on axle No. 2 turn from stop to stop, reconnect reach rod steering cylinder hose to No. 1 axle, disconnect axle No. 2 and continue the test on axle No. 1

Table 2-9. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

FRAME COMPONENTS

1. REAR TOW PINTLE DOES NOT PIVOT, LATCH OR JAW STUCK.
   Step 1. Check for insufficient lubrication.
   Clean, lubricate, and free pintle. Use a pry bar as required.
   Step 2. Check for damaged or defective pintle.
   Replace pintle assembly (para 2-146).
2. EXCESSIVE CHUCKING OF TOWED TRAILER. (A HEAVY OR LOUD THUMP FROM FIFTH WHEEL AREA WHEN STARTING OR STOPPING VEHICLE OR CONSTANT THUMP WHEN MOVING).
   Step 1. Check for loose fifth wheel support bracket mounting bolts.
   Tighten mounting bolts (para 2-145).
   Step 2. Inspect coupler jaws and coupler lock for wear or damage.
   Replace fifth wheel assembly (para 2-145).
   Step 3. Refer to trailer manual and check for worn or damaged kingpin on towed trailer.
   Refer to trailer TM 9-2330-294-14, TM 9-2330-294-24P.
3. NOISY OR POPPING SOUNDS FROM FIFTH WHEEL WHEN TURNING.
   Uncouple trailer and inspect for insufficient lube on fifth wheel base plate.
   Clean and relubricate base plate (LO 9-2320-258-12).

Table 2-10. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

BODY AND CAB

1. CAB LOOSE ON FRAME OR SAGGING TO ONE SIDE.
   Inspect condition of cab mount rubber springs. Check adjustment of mount assemblies (refer to para 2-157).
   Replace cab mounted spring or adjust as required (para 2-157).
2. CAB TOP OR WINDSHIELD LOOSE.
   Inspect for loose screws.
   Tighten screws.
3. DOOR HARD TO OPEN OR CLOSE, DOES NOT LATCH WHEN CLOSED OR LOCKS WHEN CLOSED FROM OUTSIDE.
   Step 1. Check for insufficient lube or hinges or latch.
   Lubricate hinges or latches.
   Step 2. Check for defective door latch.
   Replace door latch.
   Step 3. Check for strike plate out of position.
   Reposition strike plate (para 2-155).
4. WINDOWS DO NOT LIFT OR LOWER.
   Check for broken regulator chain.
   Replace regulator (para 2-155).
5. WINDSHIELD WASHER DOES NOT FUNCTION OR DOES NOT SPRAY WINDSHIELD PROPERLY (RESERVOIR FULL).
   Step 1. Inspect for clogged strainer at bottom of reservoir pick-up tube.
   Clean strainer.
   Step 2. Check for damaged or clogged tubing between reservoir and pump or between pump and nozzle. Disconnect tubes at pump, reservoir, and nozzles and check for clogging of tubes.
   Replace or repair damaged, kinked or clogged tubes as necessary (para 2-89).
   Step 3. Inspect pump for cracks, holes or leakage in bellows. Disconnect output tube and actuate pump and observe for discharge of water.
   Replace pump (para 2-82).
   Step 4. Check nozzle for clogs and adjustment.
   Clean, adjust or replace nozzle as necessary (para 2-89).

Table 2-11. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WINCH HYDRAULIC SYSTEM

1. NEITHER WINCH OPERATES.
   Step 1. Check winch suction hose gate valve to ensure it is open.
   Open winch suction hose gate valve.

Table 2-11. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Check sight gage on reservoir for proper oil level.
Fill reservoir to proper level (refer to LO 9-2320-258-12).

Step 3. Visually check position of filter restriction indicator on the hydraulic reservoir.
Service filter if required (refer to LO 9-2320-258-12).

Step 4. Check to see if solenoid valve is functioning. Start engine and completely depress the accelerator under a no-load condition. Assure that engine maintains approximately 2600 to 2700 rpm. Reduce engine speed to idle (550 to 650 rpm) and engage the winch PTO. With the winch PTO engaged completely, depress the accelerator. Engine should maintain approximately 1700 rpm. Repeat step 4 at the winch operating station.
Refer to Winch PTO troubleshooting, table 2-23.

Step 5. Observe appearance and level of oil in sight glass and in filler neck. If oil is a light color and foamy or level increases when PTO is actuated, oil is being aerated.
Visually inspect pump suction hose for evidence of leakage. Tighten hose where necessary or replace if damaged.

Step 6. Check for defective PTO/pump assembly. Visually inspect two oil lines from PTO to solenoid valve for damage that would kink or restrict oil flow in lines. Repeat test and inspection method step 4. With the PTO for winch engaged, if the engine rpm increases substantially above 1700 rpm, the PTO/pump assembly is defective.
Replace PTO/pump assembly (refer to para 2-176).

2. ONE WINCH DOES NOT OPERATE IN EITHER DIRECTION.

Step 1. Visually inspect winch pump pressure hose, suction hose, valves, fittings, and tubes for evidence of leakage.
Repair all leaks by tightening fittings or replacing components as necessary.

Step 2. Check winch suction hose gate valve to ensure it is fully open.
Open winch suction hose gate valve.

Step 3. Check for defective pressure relief valve. Install pressure gage in the end of check test tube (para 2-172*b*). Start engine and adjust speed for winching. Actuate winch control level to CABLE OUT position and observe the gage. Gage should indicate 1350 psi or greater.
Replace relief valve (para 2-173).

Step 4. Check for defective directional control valve. Disconnect ¼-inch tube connecting anticavitation valve to winch motor at winch motor tube (view B, fig. 267). Install a pressure gage with adapter in nut on winch motor tube. Start engine and operate at winch speed.

WARNING

Remove cable clevis from stowage eye on winch
platform before performing winch pressure tests.

Actuate directional valve control handle to CABLE IN position and observe gage. Gage should indicate 1350 psi or greater. Move control lever to CABLE OUT position and observe that winch turns.

NOTE

Winch should not turn in CABLE IN direction during this test.

Replace directional control valve (para 2-173).

Step 5. Check for damaged or clogged brake pressure line. Disconnect brake line at winch brake. Start engine and operate at idle. Actuate PTO switch and observe oil escaping from end of brake line.
Replace damaged brake line.

Step 6. Check for defective winch, step 1 through step 4 above.
Replace winch (para 2-178).

3. ONE WINCH DOES NOT TURN IN CABLE "IN" DIRECTION.

Step 1. Visually inspect pilot tube to anticavitation valve for kinks or clogging.
Replace tube (para 2-172).

Step 2. Check for defective anticavitation valve. Refer to malfunction 2, step 2. No leakage is permitted from open end of pilot tube in 30 seconds of testing.
Replace anticavitation valve (para 2-173*a*).

Step 3. Check for defective winch.
Replace winch (para 2-178).

Table 2-12. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NON-ELECTRICAL GAGES

1. THE SPEEDOMETER NEEDLE OR ENGINE RPM NEEDLE ERRATIC OR NOT INDICATING.

NOTE

A slight jitter in the tachometer needle at idle and in the
speedometer at speeds below 5 mph is normal.

Step 1. Visually inspect along housing for evidence of loose connections, missing clamps or damage at the tachograph head, engine or transfer case adapters, or at the inline adapters along cable. Check for loose or missing hold down clamps, damaged or crushed drive cable housing.

Table 2-12. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Tighten fittings and clamps or replace where necessary (para 2-98).
Step 2. Remove right angle drive adapters and check for smooth operation and lubrication.
Replace drive adapters (para 2-98).
Step 3. Remove drive key from engine or transmission and inspect.
Replace worn or damaged drive keys (para 2-98).
Step 4. Remove cables from housing and inspect ends for damage, condition of drive cable and lubrication.
Replace damaged drive cables. Clean and lubricate (refer to LO 9-2320-258-12).
Step 5. Check for defective tachograph assembly.
Replace tachograph (para 2-76*d* and *e*).

2. ONE OR MORE TRACES DO NOT RECORD ON TACHOGRAPH CHART.
Check chart for traces indicating defective tachograph assembly.
Replace tachograph assembly (para 2-76*d* and *e*).

3. WARNING BUZZER AND LIGHT DO NOT ACTUATE WHEN ENGINE RPM IS ABOVE 2600 RPM.
Step 1. Check for defective electrical circuit. Refer to Electrical Troubleshooting table 2-17.
Refer to Electrical Troubleshooting table 2-17.
Step 2. Check for defective tachograph assembly.
Replace tachograph assembly (para 2-76*d* and *e*).

4. AIR PRESSURE GAGE DOES NOT INDICATE.
Check for broken gage or line. Use master gage.
Refer to brake system troubleshooting table 2-7.

Section VI. TROUBLESHOOTING THE ELECTRICAL SYSTEM

2-18. General

a. This section contains detailed troubleshooting information for locating and correcting malfunctions in the electrical system of the M746 truck tractor. Each of the functional systems is treated separately by means of:

(1) A physical and functional description.

(2) A brief overall system check to determine if the complete system is operating properly.

(3) A simplified circuit diagram to clarify circuits, circuit components, and disconnect points.

(4) Step-by-step tests to diagnose trouble using authorized test equipment.

b. This section also includes a list of electrical circuit numbers with a brief description of each. A complete vehicle circuit diagram is provided in figures FO-1 and FO-2.

NOTE

Electrical leads on the vehicle are marked with a circuit-numbered metal band attached to the junction or terminal end of each lead.

WARNING

Because of their higher power capabilities, 24-volt systems are more dangerous to components than 6- or 12-volt systems. Certain precautions must be observed before beginning any tests on the 24-volt system. Do not permit a "hot" wire to touch metal parts of the vehicle at any time. "Flash" testing by striking a hot wire against a vehicle ground will cause an arc that will completely destroy the connector or the lead. Accidental contact of metal tools between battery or starter cables and the frame of the vehicle causes a direct short circuit resulting in arcing and instant heating of the tool. This can cause painful burns on the hands and serious damage to tools, vehicle components, and batteries. Moreover, the overloaded battery may explode, spraying hot acid and sharp fragments over the surrounding area. The correct procedure when removing electrical equipment, harnesses, battery cables or starter cables, is to disconnect the battery ground cable first. Protect the ground cable from accidental contact with the battery terminal. When the work has been completed, connect the battery ground cable last.

2-19. How to Troubleshoot the System Circuits

a. To successfully troubleshoot the electrical system, analyze the entire system as follows:

(1) Attempt to isolate the system (lighting, starting, etc.) in which the malfunction occurs.

(2) Isolate the circuit within the system that is not working.

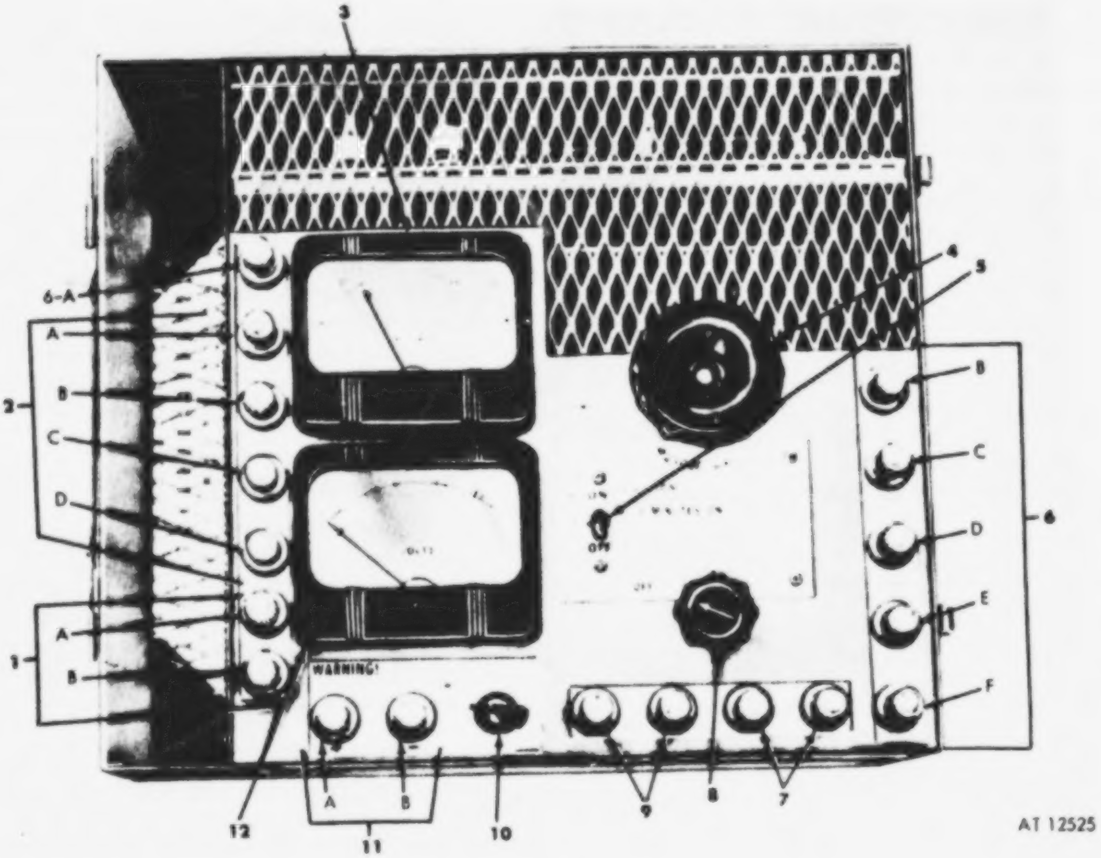
(3) Isolate the individual component within the circuit that is causing the trouble.

b. Question the vehicle operator to obtain the maximum number of observed symptoms. The greater the number of symptoms of trouble that can be evaluated, the easier will be the isolation of the primary cause or defect.

2-20. System Circuits

The functional system circuits covered in this manual are in the following sequence:

	System	Table
1	Battery	2-13
2	Starting	2-14
3	Transmission Range Selector	2-15
4	Gages and Sending Units	2-16
5	Warning Lights and Buzzer	2-17
6	Windshield Wiper Motors	2-18
7	Defroster Blower Motors	2-19
8	Personnel Heater	2-20
9	Transmission Retarder Brake Switch and Trailer Brake Switch	2-21
10	Fuel Shutoff and Auxiliary Fuel Pump	2-22
11	Winch PTO	2-23
12	Air Horn	2-24
13	Warning Beacon and Trailer Auxiliary Outlet	2-25
14	Lighting	2-26
15	Directional Signal	2-27
16	Floodlight and Utility Outlet	2-28
17	Alternator Charging	2-29
18	Battery Heat	2-30



1 External shunt binding posts
  A - Negative
  B - Positive
2 Ammeter binding posts
  A - Positive
  B - 100 amp negative
  C - 50 amp negative
  D - 10 amp negative
3 Ammeter
4 Load bank control
5 Load bank switch
6 Load bank binding posts
  A - Common
  B - 6 volts, 5-100 A
  C - 12 volts, 50-100 A
  D - 12 volts, 5-50 A - 24 volts, 80-100 A
  E - 24 volts, 10-80 A
  F - 24 volts, 5-10 A
7 ¼-ohm resistor binding posts
8 Field rheostat control
9 Field rheostat binding posts
10 Voltmeter range selector switch
11 Voltmeter binding posts
  A - Positive
  B - Negative
12 Voltmeter

Figure 2-4. Low voltage circuit tester TV-100.

2-21. Test Equipment

a. Description.

(1) *Low Voltage Circuit Tester.* Figs. 2-4 through 2-7 illustrate some of the types of low voltage circuit testers (LVCT) in general use. The LVCT consists of a voltmeter, an ammeter, a fixed resistance, load bank, and field rheostat unit. They are mounted in a metal case, which also provides stowage space for the meter leads and accessories (fig. 2-8) used for making all the necessary tests. Other test sets are similar, and all tests described in this section can be performed equally well with these testers. Figure 2-9 shows a schematic diagram of two typical testers, to better understand how the tester components function with the circuit being tested.

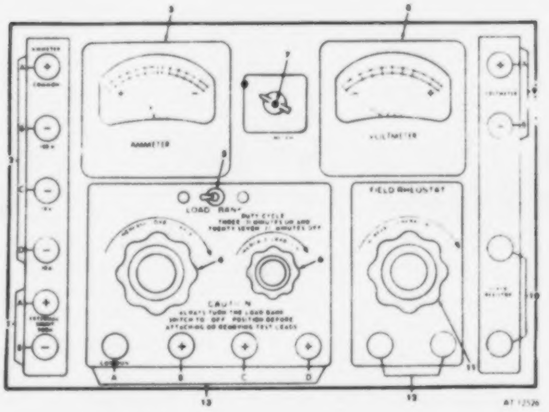
(2) *Multimeter.* The multimeter (fig. 2-10) is a lightweight portable instrument for use in making voltage tests where load banks or ammeter ranges are not required. The multimeter is also useful in making resistance or continuity tests of components suspected of being open, intermittent or short-circuited.

b. Low Voltage Circuit Tester Functions and Use.

NOTE

The key numbers noted in parentheses are in figure 2-4 except where otherwise noted.

(1) *Voltmeter.* The two voltmeter binding posts (11), marked positive (+) and negative (-) are used for making voltage tests of batteries, generators or wiring circuits. Four meter ranges (1, 10, 20 and 50 volts) are available, selected by the voltmeter range selector switch (10).



1 External shunt binding posts
  A - Positive
  B - Negative
2 Ammeter binding posts
  A - Positive
  B - 100 amp negative
  C - 50 amp negative
  D - 10 amp negative
3 Ammeter
4 Load bank control, coarse
5 Load bank switch
6 Load bank control, fine
7 Voltmeter range selector switch
8 Voltmeter
9 Voltmeter binding posts
  A - Positive
  B - Negative
10 ¼-ohm resistor binding posts
11 Field rheostat control
12 Field rheostat binding posts
13 Load bank binding posts
  A - Common
  B - 6 volts
  C - 12 volts
  D - 24 volts

Figure 2-5. Low voltage circuit tester EMC 1060.

(2) *Ammeter.* Four ammeter binding posts (2) are provided for making current readings up to 100 amperes. One terminal (A) is a common positive (+) terminal; the others (B, C, D) provide a selection of three negative ranges of 10, 50 or 100 amperes. Two binding posts (1) are provided for the connection of an external shunt assembly to extend the ammeter range to 500 amperes for the measurement of heavy currents.

(3) *Fixed ¼-ohm Resistance Unit.* Two binding posts (7) provide fixed ¼-ohm resistance for use in charging circuit tests. Although the ammeter is used for these tests, the ¼-ohm resistor has no internal connection to the ammeter.

(4) *Field Rheostat Unit.* Two binding posts (9) provide a changeable resistance for use in generator and changing circuit tests. There is no internal connection between the field rheostat unit and any other component of the tester.

(5) *Load Bank.* Six binding posts (6) provide the proper load resistances to set up generator charging rate tests for various battery and generator voltages. The common binding post (6A) is connected internally to the ammeter positive (+) binding post (2A) eliminating the need for a jumper lead when making load tests. The load resistance may be changed by the load bank control knob (4) or removed from the circuit by the load bank switch (5).

c. Multimeter Functions and Use.

(1) *DC Voltmeter.* The voltmeter (fig. 2-11) is similar to the voltmeter portion of the LVCT. Three meter ranges (2.5, 10 and 50 volts) are available for use in automotive testing. Three additional ranges (250, 500 and 1000 volts) are useful in testing electronic equipment. Ranges are selected by plugging test lead into proper range jack.

(2) *AC Voltmeter.* The ac voltmeter (fig. 2-12) is used for making tests of lighting and power systems. Although several ranges are provided on the meter, only the 250-volt range is used for troubleshooting the lighting and power systems.

(3) *Ohmmeter.* The ohmmeter (figs. 2-13 and 2-14) is used for making resistance and continuity tests. The ohmmeter is basically a voltmeter and internal battery connected in series so that when the two test leads are connected together, the voltmeter reads the battery voltage. When a conductive circuit is connected between the test leads, the voltmeter will indicate how much voltage is being lost (voltage drop) in the circuit. In the case of a length of wire, there will be little or no drop; for a small coil or a resistor, there may be considerable voltage drop. The amount of voltage drop is directly related to the resistance (in ohms) of the component being tested.

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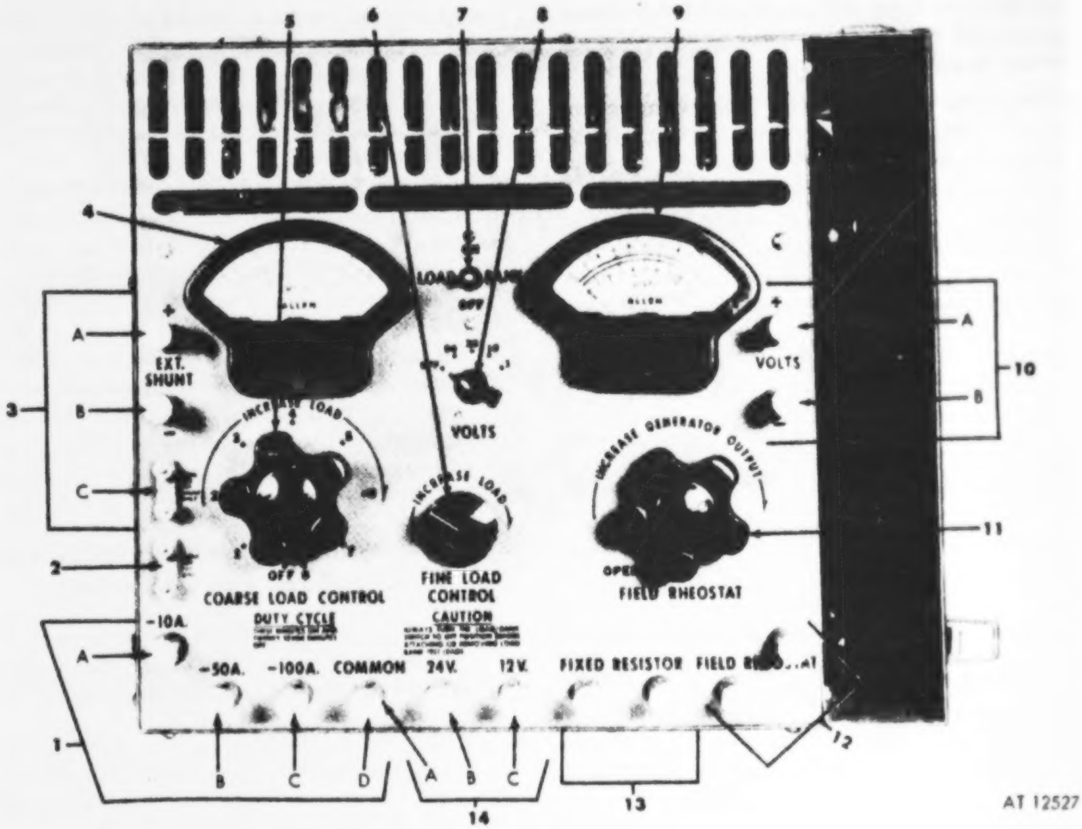

1
2
3
4
5
6
7
8
9
10
11
12
13
14
A
B
C
D
EXT. SHUNT
LOAD BANK
OFF
VOLTS
INCREASE LOAD
COARSE LOAD CONTROL
DUTY CYCLE
FINE LOAD CONTROL
CAUTION
INCREASE GENERATOR OUTPUT
OPEN
FIELD RHEOSTAT
-10A.
-50A.
-100A.
COMMON
24V.
12V.
FIXED RESISTOR
FIELD RHEOSTAT
ALLEN
AT 12527

1 Ammeter binding posts
  A - 10 amp negative
  B - 50 amp negative
  C - 100 amp negative
  D - Positive
2 Load bank link, 12 volt
3 External shunt binding posts
  A - Positive
  B - Negative
  C -Disconnect link
4 Ammeter
5 Load bank control, coarse
6 Load bank control, fine
7 Load bank switch
8 Voltmeter range selector switch
9 Voltmeter
10 Voltmeter binding posts
  A - Positive
  B - Negative
11 Field rheostat control
12 Field rheostat binding posts
13 ¼-ohm resistor binding posts
14 Load bank binding posts
  A - Common
  B - 24 volts
  C - 12 volts

Figure 2-6. Low voltage circuit tester Allen 30-92.

(4) *Other Scales.* Since the multimeter is a general purpose instrument intended primarily for electronic testing, other scales and ranges are provided. These ranges are not normally used for automotive vehicle electrical troubleshooting and are beyond the scope of this manual.

2-22. General Instructions for Use of Test Sets and Multimeter

CAUTION

Before proceeding with vehicle troubleshooting procedures, paragraphs 2-23 and 2-24 must be read and understood by all personnel using the test set. Incorrect connections to the test set could result in costly damage to test equipment or vehicle components.

a. Be sure of test to be made and procedure to be used. Follow step-by-step procedure given for each individual test.

b. Always select a meter range higher than the expected reading. Set tester for this range before connecting it into circuit.

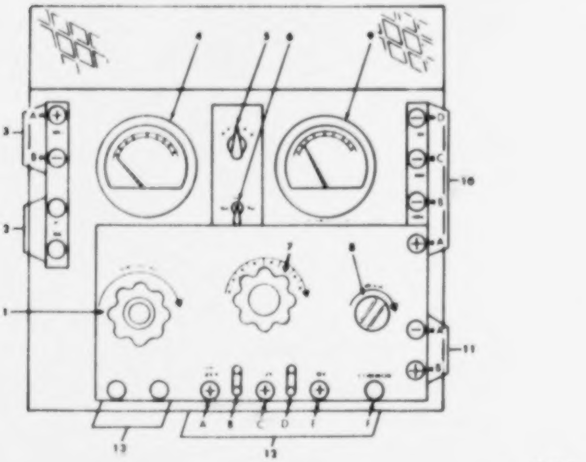
c. Be sure to read correct row of meter scale figures which correspond to the selected range. The range selector switch or the binding post marking always shows the right-hand figure of the row to be used. For example, if the range selector is set for 50 volts, read the row of meter scale figures that ends with 50 on the right-hand end.

d. When testing with an ammeter or ammeter shunt, always connect it in series with circuit to be tested. Power should be turned off when connecting or disconnecting the ammeter or ammeter shunt.

e. When testing with a voltmeter, always connect it in parallel with (across) terminals of component to be tested. Where terminals are easily accessible, power may be left while attaching leads to make voltage tests. Where there is a possibility of touching an adjacent terminal or vehicle frame when attaching the positive (red) test lead clip, the power should be off and the test lead clipped securely to the terminal to be tested before restoring power.

CAUTION

Never attempt to make resistance tests until all sources of power connected to the circuit or device to be tested are disconnected. The multimeter will be damaged if this procedure is not followed.



1 Field rheostat control
2 ¼-ohm resistor binding posts
3 Voltmeter binding posts
  A - Positive
  B - Negative
4 Voltmeter
5 Voltmeter range selector switch
6 Load bank switch
7 Load bank control, coarse
8 Load bank control, fine
9 Ammeter
10 Ammeter binding posts
  A - Positive
  B - 100 amp negative
  C - 50 amp negative
  D - 10 amp negative
11 External shunt binding posts
  A - Negative
  B - Positive
12 Load bank binding posts
  A - 24 volts
  B - 12 volt link
  C - 12 volts
  D - 6 volt link
  E - 6 volts
  F - Common
13 Field rheostat binding posts

Figure 2-7. Low voltage circuit tester RAM 62F151.

f. When testing with an ohmmeter, always connect it in parallel with (across) terminals of component to be tested. (If component has only a single terminal, connect between terminal and metallic frame of component.) In addition, component being tested must be electrically free from the circuit. Remove all connections to component before making any resistance or continuity tests. The component may remain mounted in vehicle provided all other circuit connections have been removed. One terminal of most automotive electrical components is grounded to the vehicle. A negative ground wire is included in all cable runs. Most components are connected to this ground circuit.

g. Always handle test sets carefully. Although test set is ruggedly built, meter movements are delicate mechanisms and can be damaged easily by rough handling. Be sure to stow all test leads and adapters in their proper compartments after tests have been completed.

CAUTION

In choosing a location for low voltage circuit tester, at vehicle or on service bench, be sure to place tester in a position that will not restrict air flow through bottom and top openings. Do not exceed duty cycle of 3 minutes "ON" and 27 minutes "OFF".

2-23. Specific Instructions for Use of the LO Voltage Circuit Testers

NOTE

The key numbers noted in parentheses are in figure 2-4, except where otherwise noted.

a. DC Voltage Tests.

(1) Determine exactly what is to be tested, where test leads will be connected, and what voltage to expect.

(2) Voltage must be measured at exact circuit point specified in Electrical Troubleshooting tests. Resistance of poor wiring, connections, and switch contacts can cause errors if voltages are measured at points elsewhere in the circuit or on other parts of the component.

(3) Connect voltmeter test leads (fig. 2-8) to voltmeter binding posts (11, fig. 2-4). Connect black lead to negative (-) post (B), and red lead to positive (+) post (A).

(4) Set voltage range selector switch (10) to a range higher than expected voltage. Determine exactly which row of figures you will read.

CAUTION

Paragraph (4) above must be done before (5). A voltage range setting lower than the circuit voltage will damage the meter when (6) is performed.

(5) Connect negative (black) lead first to circuit to be tested. This will usually be the negative ground terminal for cab and chassis components or the engine frame for engine components.

(6) Touch positive (red) lead to other circuit connection. If meter needle moves to left, reverse test leads at circuit - not at tester binding posts.

(7) Read voltage carefully, facing meter squarely. Viewing meter from an angle will result in inaccurate readings.

b. DC Current Tests.

(1) Determine exactly what is to be tested, where

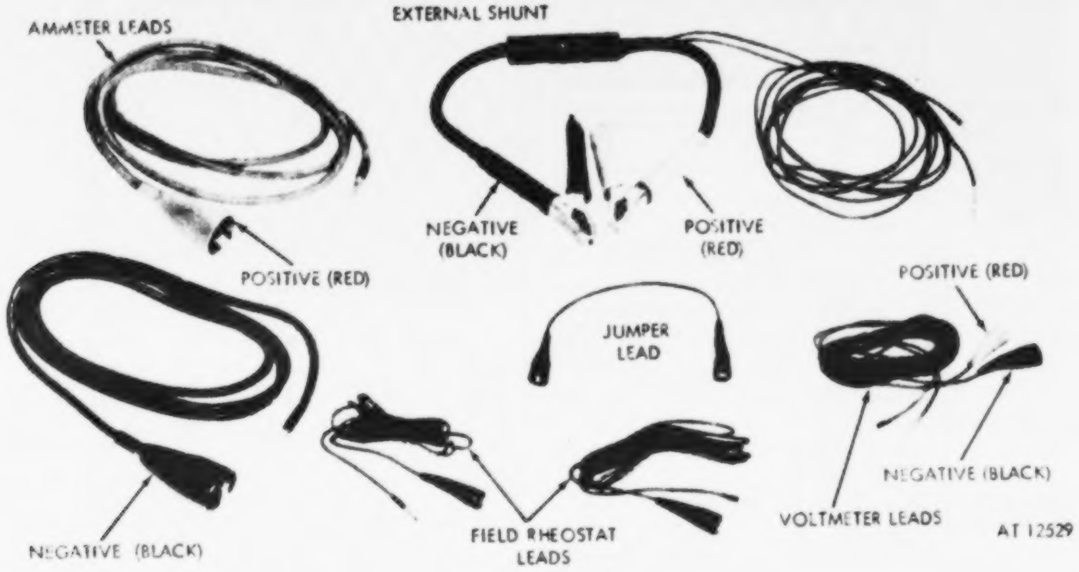


Figure 2-8. Test leads for use with low voltage circuit testers.

test leads will be connected, and what amperage to expect.

(2) Amperage may be measured at any convenient point in a single circuit, since the current is always the same throughout the circuit.

(3) Connect ammeter red test lead (fig. 2-8) to positive (+) binding post (2A, fig. 2-4). Tighten binding post securely.

(4) Select a negative binding post (2B, C or D, fig. 2-4) marked with an amperage range higher than expected amperage. Connect ammeter black test lead (fig. 2-8) to this selected binding post and tighten binding post securely. Determine exactly which row of figures on ammeter you will read.

CAUTION

Paragraph (4) above must be done before (5). An amperage range lower than the circuit current will damage the meter when (6) is performed.

(5) Be sure that no power is being applied to circuit to be tested. Separate circuit at a convenient junction point to form two connection points. Connect red wire to connection point which is electrically closer to battery positive (+) terminal. Connect black wire to other connection point.

(6) Apply power to circuit momentarily, observing ammeter. Needle should move to right. If needle moves to left, interchange red and black wires at circuit test points - not at tester binding posts.

(7) Read ammeter carefully, facing meter squarely. Viewing meter from an angle will result in inaccurate readings.

(8) Remove power from circuit before disconnecting test leads.

c. DC Current Tests with Ammeter Shunt.

(1) When current exceeding 100 amperes is expected, the external shunt assembly (fig. 2-8) should be used. The shunt assembly consists essentially of a power resistor which passes 98 percent of the circuit current and allows only 2 percent to be sent to the meter. Thus, if the circuit current was 200 amperes, 196 amperes would pass through the shunt and 4 amperes would be sent to the meter. The 500-ampere figures on the meter scale are used for this shunt. A 200-ampere current through the shunt will indicate a reading of 200 on the meter scale, although a current of only 4 amperes is actually flowing through the meter.

(2) Disconnect power to circuit to be tested. Connect small diameter shunt leads to shunt binding posts of tester (1, fig. 2-4); red lead positive (+) binding post (B), and black lead to negative (-) binding post (A).

(3) Connect heavy shunt leads to circuit to be tested. Make sure all connections are tight.

(4) Follow all instructions give in *b* (5), (6), (7), and (8) above.

d. Load Bank and Field Resistance Tests.

(1) Three or more sections of the tester are used for these tests: the voltmeter, ammeter, and one or more of the resistances. Use extreme caution when connecting the test leads; severe damage can be caused to the tester and the components being tested if the test setup is incorrect. Follow individual test setup illustration for specific test being made.

(2) Observe precautions in *a* and *b* above, for use of voltmeter and ammeter.

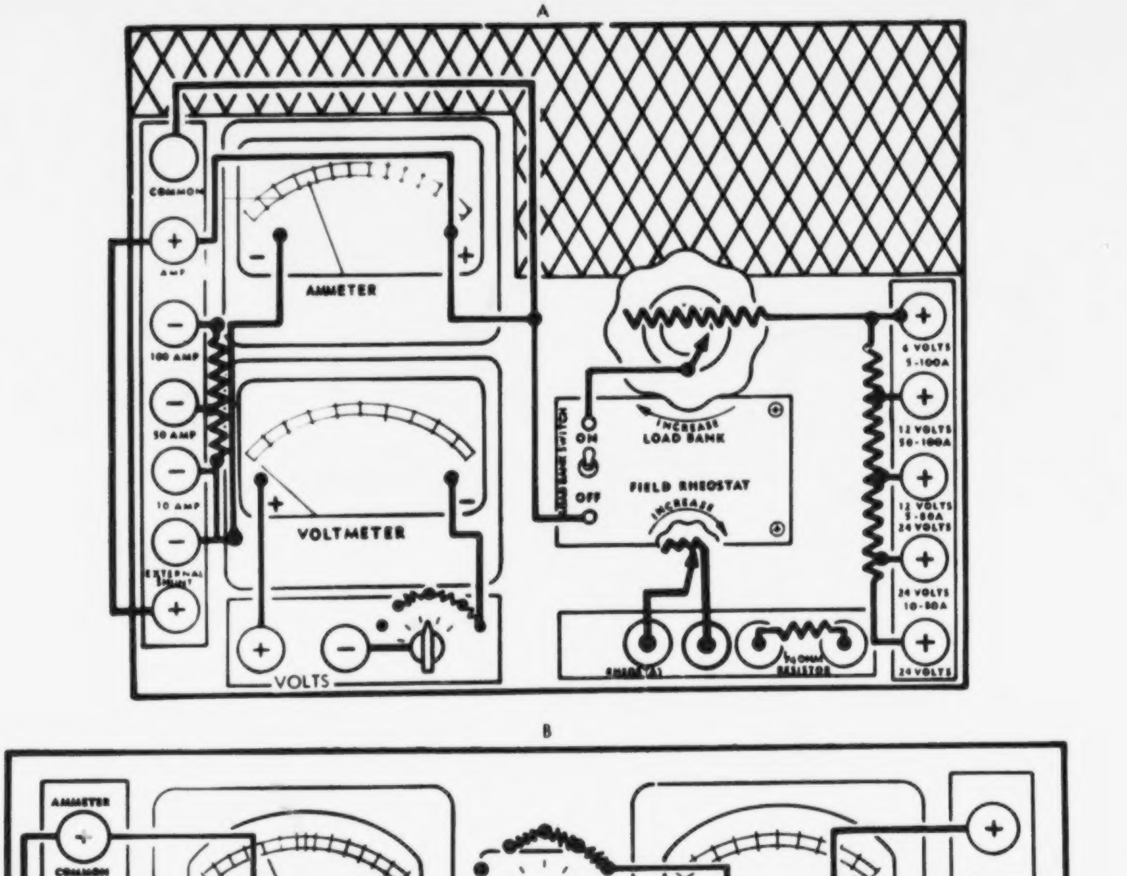
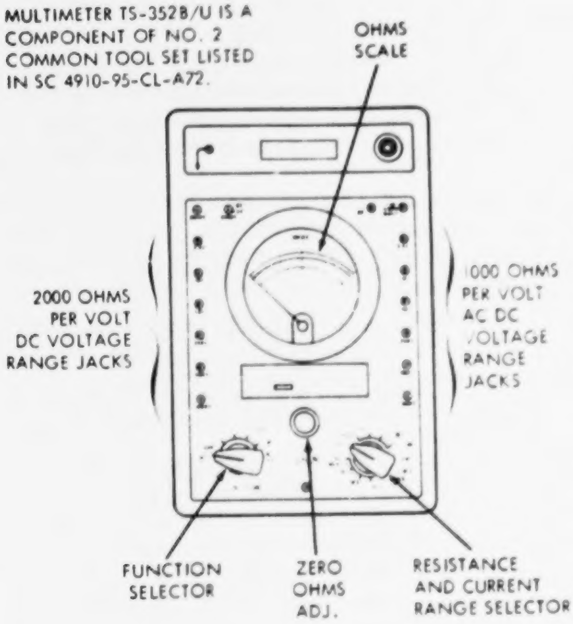

A
COMMON
AMP
100 AMP
50 AMP
10 AMP
EXTERNAL SHUNT
AMMETER
VOLTMETER
VOLTS
LOAD BANK SWITCH
ON
OFF
INCREASE
LOAD BANK
FIELD RHEOSTAT
INCREASE
SHUNT(A)
RESISTOR
6 VOLTS 5-100A
12 VOLTS 50-100A
12 VOLTS 5-50A 24 VOLTS
24 VOLTS 10-50A
24 VOLTS
B
AMMETER
COMMON
100A
50A
10A
EXTERNAL SHUNT 300A
AMMETER
VOLTMETER
VOLTMETER
VOLTMETER
LOAD BANK
DUTY CYCLE
THREE (3) MINUTES ON AND
TWENTY-SEVEN (27) MINUTES OFF
INCREASE LOAD-COARSE
INCREASE LOAD-FINE
CAUTION
ALWAYS TURN THE LOAD BANK
SWITCH TO "OFF" POSITION BEFORE
ATTACHING OR REMOVING TEST LEADS
COMMON
FIELD RHEOSTAT
INCREASE GENERATOR OUTPUT
FIXED RESISTOR
AT 12530

Figure 2-9. Schematic layout of low voltage circuit testers (typical).


MULTIMETER TS-352B/U IS A COMPONENT OF NO. 2 COMMON TOOL SET LISTED IN SC 4910-95-CL-A72.

OHMS SCALE
2000 OHMS PER VOLT DC VOLTAGE RANGE JACKS
1000 OHMS PER VOLT AC DC VOLTAGE RANGE JACKS
FUNCTION SELECTOR
ZERO OHMS ADJ.
RESISTANCE AND CURRENT RANGE SELECTOR

TA027795

Figure 2-10. Multimeter - TS-352B/U.

(3) Both the LOAD BANK (4, fig. 2-4) and FIELD RHEOSTAT (8, fig. 2-4) knobs should be in the extreme counterclockwise position before connecting the load bank or field rheostat to the circuit being tested.

- CAUTION

The nameplates on the LOAD BANK and FIELD RHEOSTAT controls indicate clockwise rotation is required for an increase in current. However, to accomplish this effect, the actual resistance presented to the circuit is decreased with clockwise rotation of these controls. Refer to figure 2-9.

(4) Whenever resistances carry heavy currents, considerable heat is developed. To prevent heat damage to the resistors and other tester components, power should be applied to the resistors for not more than 3 minutes continuously. At least 27 minutes off-time is required to allow the resistors to cool down sufficiently for another three-minute period of operation. Be sure there is sufficient ventilation provided for the tester. Before applying power to the circuit, have all connections in place, and be ready to make the necessary adjustments and meter readings as rapidly as possible consistent with accuracy and safety.

(5) Do not turn LOAD BANK SWITCH (5, fig. 2-4) to OFF position while power is applied to circuits. The switch contacts will arc and burn when subjected to heavy battery currents.

2-24. Specific Instructions for Use of the Multimeter

a. DC Voltage Tests.

(1) Determine exactly what is to be tested, where test leads will be connected, and what voltage to expect.

(2) Voltage must be measured at the exact circuit point specified in the Electrical Troubleshooting tests. Resistance of poor wiring, connections, and switch contacts can cause errors if voltages are measured at points elsewhere in the circuit.

(3) Plug voltmeter test leads (fig. 2-11) into multimeter jacks. Plug back lead into jack marked "-DC/± AC/OHMS."

(4) Plug red lead into a jack in the 20,000 ohms per volt DC panel, and select a range higher than expected voltage. Determine exactly which row of figures you will read, "-DC/± AC/OHMs."

CAUTION

Paragraph (4) above must be done before (5). A voltage range setting lower than the circuit voltage will damage the meter when (6) is performed.

(5) Connect negative (black) lead first to circuit to be tested. This will usually be negative ground terminal for cab and chassis components or engine frame for engine components (fig. 2-11).

(6) Touch positive (red) lead to the other circuit connection. If the meter needle moves to the left, reverse test leads at circuit, not at multimeter jacks.

(7) Read voltage carefully, facing meter squarely. Viewing meter from an angle will result in inaccurate readings.

b. AC Voltage Tests.

(1) Determine exactly what is to be tested, where test leads will be connected, and what voltage to expect.

(2) Voltage is to be measured at the exact circuit points specified in the Electrical Troubleshooting tests. Resistance of poor wiring, connections, and switch contacts can cause errors if voltages are measured elsewhere in the circuit.

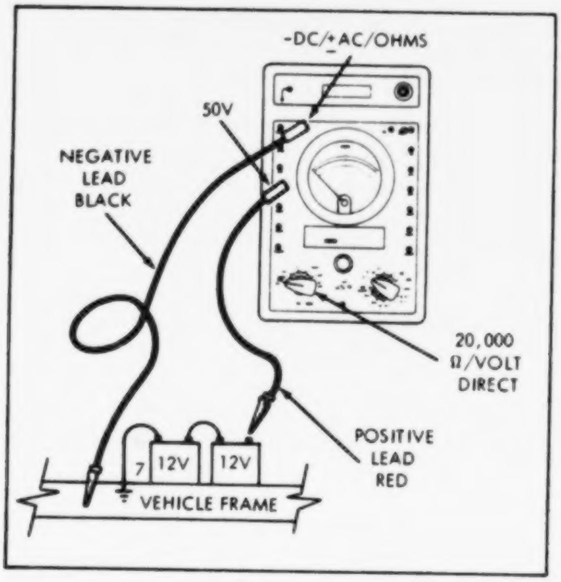
(3) Plug voltmeter test leads (fig. 2-12) into multimeter jacks. Plug black lead into jack marked "DC/±AC/OHMS".

(4) Plug red lead into jack marked "250v/1000 ohms per volt ACDC." Determine exactly which row of figures you will read.

(5) Be sure component to be tested is clear of any metallic structural element of vehicle. If in close quarters, turn off power switch or circuit breaker feeding circuit, and clip test leads carefully to terminals to be tested. Dress clips so they touch terminals only and do not touch each other or any nearby metallic parts.

(6) Turn on power and read voltage carefully, facing meter squarely. Viewing meter from an angle will result in inaccurate readings.

(7) Turn off power before touching or removing test lead clips.


-DC/±AC/OHMS
50V
NEGATIVE LEAD BLACK
20,000 Ω/VOLT DIRECT
POSITIVE LEAD RED
7
12V
12V
VEHICLE FRAME

DC VOLTAGE TEST

(USED TO MEASURE BATTERY VOLTAGE, VOLTAGE DROPS, OR DC VOLTAGE AT TEST POINTS.)

1. SET FUNCTION SELECTOR ON 20,000 Ω/VDC DIRECT.
2. PLUG POSITIVE LEAD (RED) INTO 50V, 20,000 OHMS PER VOLT DC JACK.
3. PLUG NEGATIVE LEAD (BLACK) INTO -DC/± AC/OHMS JACK AND CONNECT TO VEHICLE FRAME, ENGINE, OR OTHER NEGATIVE TEST POINT STATED IN TEST PROCEDURE.
4. TOUCH POSITIVE LEAD (RED) TO TEST POINT STATED IN TEST PROCEDURE. NEEDLE SHOULD MOVE TOWARD CENTER OF SCALE TO INDICATE VOLTAGE.

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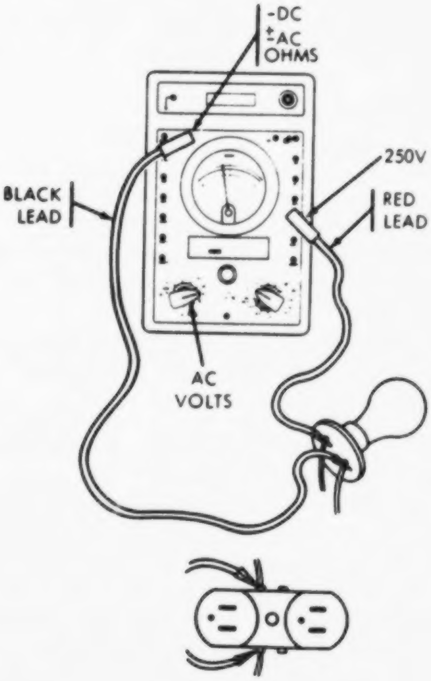
Figure 2-11. DC voltage test with multimeter.


-DC
±AC
OHMS
250V
BLACK LEAD
RED LEAD
AC VOLTS

AC VOLTAGE TEST

(USED TO MEASURE AC VOLTAGE AT VARIOUS POINTS.)

1. SET FUNCTION SELECTOR TO AC VOLTS.
2. PLUG NEGATIVE LEAD (BLACK) INTO -DC/± AC/OHMS. PLUG POSITIVE LEAD (RED) INTO 250V/1000V OHMS PER VOLT AC DC JACK.
3. WITH POWER TURNED OFF, CONNECT TEST CLIPS TO TERMINALS OF UNIT TO BE TESTED. EITHER COLOR TO EITHER TERMINAL.
4. TURN ON POWER. NEEDLE SHOULD MOVE TOWARD CENTER OF SCALE TO INDICATE VOLTAGE.
5. TURN OFF POWER BEFORE TOUCHING OR REMOVING CLIPS TO AVOID ELECTRICAL SHOCK.

TA027797

Figure 2-12. AC voltage test with multimeter.

c. Resistance and Continuity Tests.

CAUTION

> Never attempt to make resistance or continuity tests until all sources of power connected to circuit or device to be tested are disconnected. The multimeter will be damaged if this procedure is not followed.

All electrical circuits possess some resistance. Some resistances, however, are so small and others so large that they cannot be read on the same scale. When reading is obtained, it indicates the circuit has continuity (no break or openings). The following procedure must be followed to perform resistance or continuity tests:

(1) Place the FUNCTION SELECTOR switch (fig. 2-13) in OHMS position.

(2) Rotate the range selector switch to the required range to (1) R x 1 to measure resistance between 0 and 1,000 ohms and to test for continuity, (2) R x 10 to measure resistance between 0 and 10,000 ohms, (3) R x 100 to measure resistance between 0 and 100,000 ohms, (4) R x 1,000 to measure resistance between 0 and 1 megohm and (5) R x 10,000 to measure resistance between 0 and 20 megohms (megohms = million ohms).

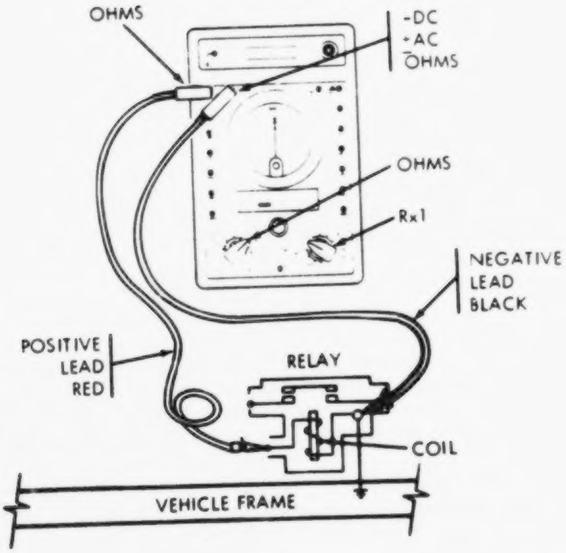
(3) Plug black lead into jack marked "-DC/±AC/OHMS," and red lead into jack marked "OHMS." Touch ends of leads together and turn ZERO OHMS knob until pointer is at zero.

(4) Separate ends of test leads, and clip leads across portion of circuit or component being tested (fig. 2-13 and 2-14). (Either of the leads may be clipped to the test points.)

(5) Read ohms on the green area at top of scale.

NOTE

> For range R x 1, read the figures directly; for range R x 10, multiply reading indicated by 10 or add one zero to reading; for range R x 100, multiply reading indicated by 100 or add two zeroes to reading; for range R x 1000, multiply reading indicated by 1,000 or add three zeroes to reading; for range R x 10,000, multiply reading indicated by 10,000 or add four zeroes to reading.
>
> Example: A 2,000 ohm resistance should be checked on the R x 100 range scale. The reading on the scale will be 20. Adding two zeroes will give 2,000 ohms.



RESISTANCE TEST

(USED TO MEASURE RESISTANCE OF COILS OR RESISTORS, AND TO LOCATE SHORT CIRCUITS.)

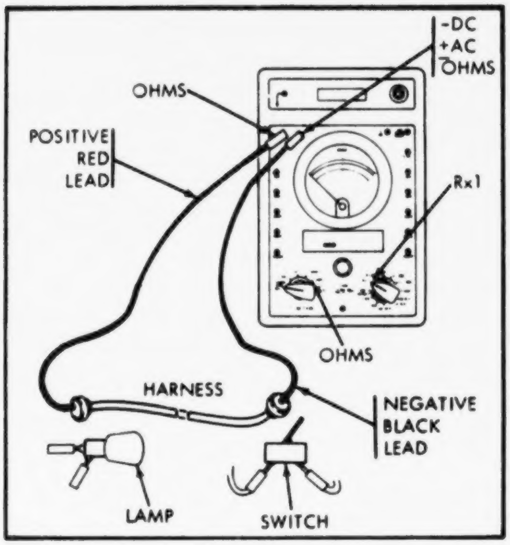
1. SET FUNCTION SELECTOR SWITCH ON OHMS.
2. SET RANGE SELECTOR SWITCH ON Rx1.
3. PLUG BLACK LEAD (NEGATIVE) INTO -DC/+AC/OHMS JACK AND RED LEAD (POSITIVE) INTO OHMS JACK.
4. TOUCH METER LEADS TOGETHER AND TURN ZERO OHMS ADJUST UNTIL NEEDLE IS ON "O" OHMS.
5. MAKE SURE THERE IS NO BATTERY VOLTAGE CONNECTED TO CIRCUIT TO BE TESTED.
6. ATTACH NEGATIVE LEAD (BLACK) TO COMPONENT FRAME, OR NEGATIVE TERMINAL.
7. TOUCH POSITIVE LEAD (RED) TO OTHER TERMINAL OF COMPONENT BEING TESTED.
8. READ RESISTANCE ON METER SCALE.
9. IF METER NEEDLE DOES NOT MOVE, CIRCUIT IS OPEN.
10. IF METER NEEDLE MOVES COMPLETELY ACROSS SCALE TO "O" A SHORT CIRCUIT EXISTS, OR A HEAVY-DUTY COMPONENT WITH VERY LOW RESISTANCE.

TA027485

Figure 2-13. Resistance test with multimeter.

(6) An infinite reading is an open circuit reading. There will be no movement of the multimeter pointer on the R x 1 when an open circuit exists. This usually indicates a broken connection somewhere. Infinite position on the ohmmeter range scale is marked with the symbol oo.

(7) A zero reading indicates a continuous circuit with resistance too low to be measured with the multimeter. Where two cable wires, or a circuit wire and a ground connection are being checked, this usually indicates a short circuit somewhere.



CONTINUITY TEST

(USED TO TEST FOR CABLE BREAKS, LOOSE WIRES, BURNT OUT LAMPS OR OTHER ITEMS.)

1. SET FUNCTION SELECTOR ON OHMS.
2. SET RANGE SELECTOR SWITCH ON Rx1.
3. PLUG BLACK LEAD (NEGATIVE) INTO -DC/+AC/OHMS JACK AND RED LEAD (POSITIVE) INTO OHMS JACK.
4. BE SURE THERE IS NO BATTERY VOLTAGE CONNECTED TO CIRCUIT TO BE TESTED.
5. ATTACH NEGATIVE LEAD (BLACK) TO ONE END OF CIRCUIT.
6. TOUCH POSITIVE LEAD (RED) TO OTHER END OF CIRCUIT. NEEDLE SHOULD MOVE TO RIGHT HAND END OF SCALE.
7. IF NEEDLE DOESN'T MOVE, CIRCUIT IS OPEN, OR LAMP IS BURNT OUT, OR COMPONENT OPEN.
8. IF NEEDLE FLICKERS, OR JUMPS BACK AND FORTH, LOOSE CONNECTIONS ARE INDICATED.

TA027486

Figure 2-14. Continuity test with multimeter.

2-25. Preliminary Checks Prior to Troubleshooting

Check vehicle battery condition prior to performing any electrical checks in the vehicle. Refer to table 2-13 for the preliminary battery checks.

Table 2-13. Troubleshooting

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

BATTERY SYSTEM

DESCRIPTION. Six 12-volt batteries, located under the passenger's seat, are connected in a series-parallel combination to provide 24 volts for the operation of all the electrical equipment on the vehicle (fig. 2-15). The negative terminals of the battery combination are connected to the tractor frame (ground). The frame then serves as the ground return for the negative terminal of the starter motor assembly, which is connected to the frame through connectors J22 and J23 on the engine left electrical disconnect panel, and the instrument panels, which are connected to the frame through connectors J2 and J4.

All cab mounted and engine mounted electrical components are provided a ground return circuit either through the instrument panel ground, an external ground lead at the component bolted to the engine or frame, or an internal ground of the component. The positive terminals of the battery combination are connected to the positive terminal of the starter assembly through circuit 6. Circuit 6 is also connected to the master relay contacts and circuit breaker 10 for distribution.

The battery jumpers, circuit 68, are connected from the positive (+) terminal of one battery to the negative (-) terminal of the battery adjacent to it to form the 24 volts operating potential. Three of these two-battery combinations are connected in parallel by circuits 6 and ground to provide the heavy current required to supply the tractor and trailer.

Table 2-13. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

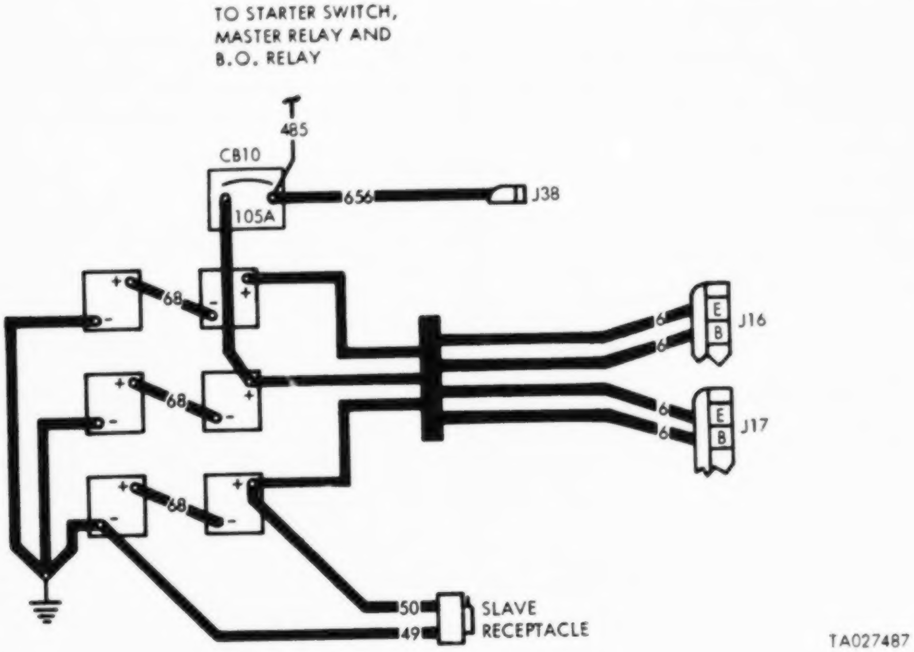

TO STARTER SWITCH,
MASTER RELAY AND
B.O. RELAY
485
CB10
105A
656
J38
68
68
68
+
-
6
6
E
B
J16
6
6
E
B
J17
50
49
SLAVE
RECEPTACLE
TA027487

Figure 2-15. Battery System

Table 2-13. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

PRELIMINARY CHECKS.

a. Battery. The vehicle battery condition should be checked prior to performing any electrical checks in the vehicle. The vehicle has six 12-volt batteries connected in series-parallel, furnishing 24 volts to the electrical system (fig. 2-15), which uses a negative (-) ground and a positive (+) power feed to the electrical components. To test battery condition, turn starter switch to ON (without starting engine). Observe battery indicator (fig. 2-16). Start engine, accelerate to about 1200 rpm, and again observe battery indicator. If indicator observations show that further tests are required, refer to troubleshooting tests 1 through 5 below.

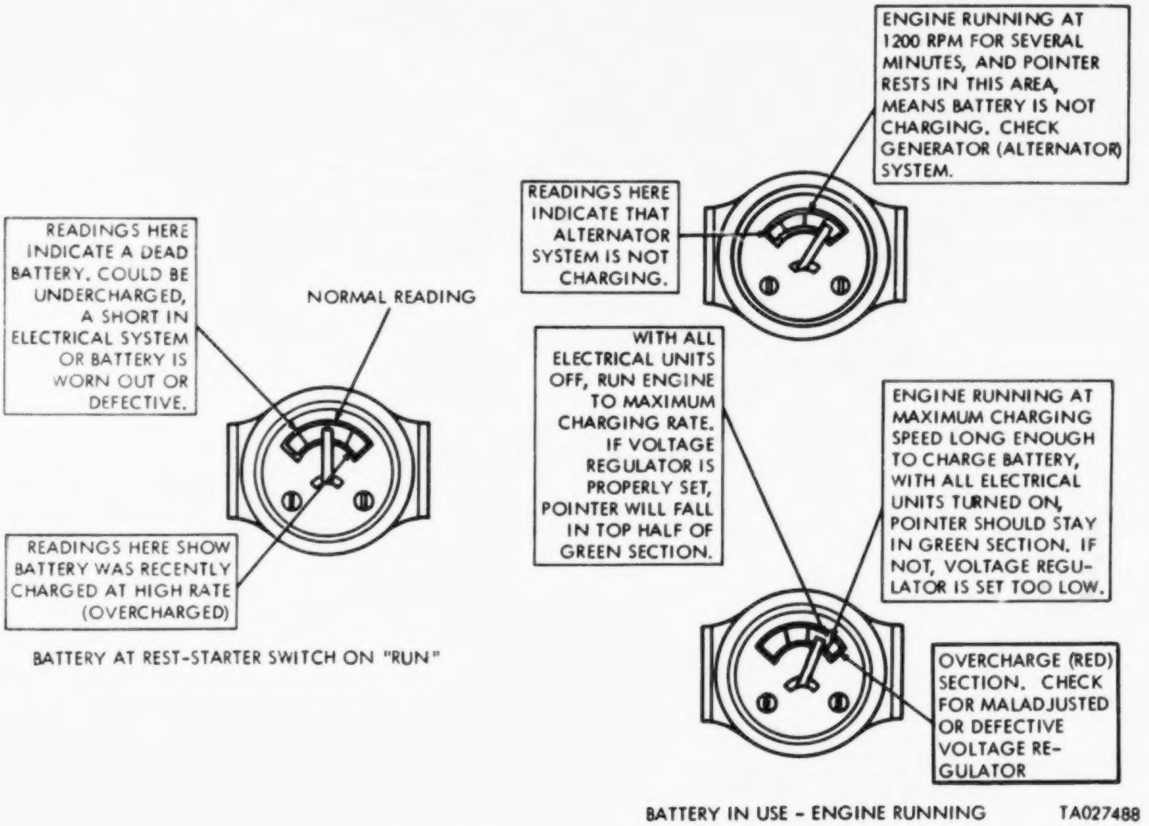

READINGS HERE INDICATE A DEAD BATTERY. COULD BE UNDERCHARGED, A SHORT IN ELECTRICAL SYSTEM OR BATTERY IS WORN OUT OR DEFECTIVE.
NORMAL READING
READINGS HERE SHOW BATTERY WAS RECENTLY CHARGED AT HIGH RATE (OVERCHARGED)
BATTERY AT REST-STARTER SWITCH ON "RUN"
ENGINE RUNNING AT 1200 RPM FOR SEVERAL MINUTES, AND POINTER RESTS IN THIS AREA, MEANS BATTERY IS NOT CHARGING. CHECK GENERATOR (ALTERNATOR) SYSTEM.
READINGS HERE INDICATE THAT ALTERNATOR SYSTEM IS NOT CHARGING.
WITH ALL ELECTRICAL UNITS OFF, RUN ENGINE TO MAXIMUM CHARGING RATE. IF VOLTAGE REGULATOR IS PROPERLY SET, POINTER WILL FALL IN TOP HALF OF GREEN SECTION.
ENGINE RUNNING AT MAXIMUM CHARGING SPEED LONG ENOUGH TO CHARGE BATTERY, WITH ALL ELECTRICAL UNITS TURNED ON, POINTER SHOULD STAY IN GREEN SECTION. IF NOT, VOLTAGE REGULATOR IS SET TOO LOW.
OVERCHARGE (RED) SECTION. CHECK FOR MALADJUSTED OR DEFECTIVE VOLTAGE REGULATOR
BATTERY IN USE - ENGINE RUNNING
TA027488

Figure 2-16. Battery generator indicator.

b. Specific Gravity. A specific gravity check should be made with a hydrometer as a routine check before making further tests. Observe the following precautions when making this check:

(1) Hold hydrometer vertically, so float does not touch sides of glass barrel. Be certain that barrel is not so full of electrolyte that float is stopped at top. Read straight across top of liquid; disregard the curvature of liquid at edge of glass and float.

(2) The electrolyte in a cell should be at normal level when reading is taken.

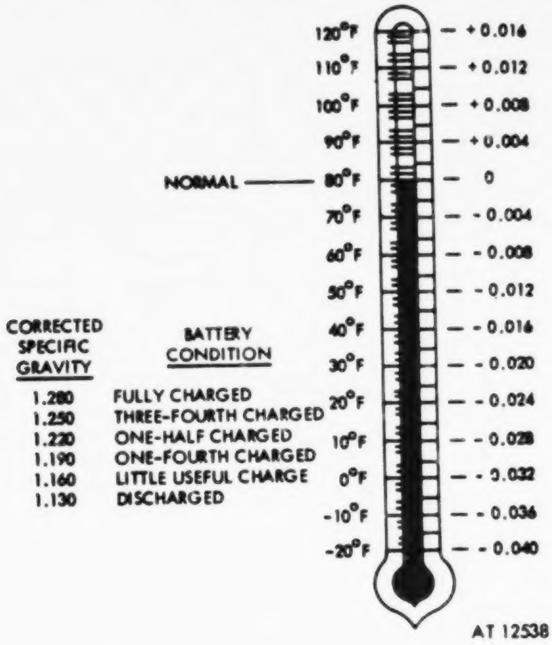
(3) When water is added, it will tend to remain at the top of the cell and a hydrometer reading will be inaccurate. It is necessary to add water to the battery before taking a reading, the battery should be charged for 1 to 2 hours to mix the electrolyte before the hydrometer is used. This may be done by connecting the battery to a charger or by operating the vehicle.

(4) Gravity readings may also be misleading if taken immediately after a battery has been discharged at a high rate, such as in prolonged cranking. Wait several hours before taking a specific gravity reading.

(5) When the temperature of the electrolyte is much greater or much less than 80°F, the specific gravity indication on the hydrometer will not be accurate. A temperature correction must be applied to the reading to obtain the correct specific gravity. Figure 2-17 shows the amount of temperature correction to be applied and how to estimate the condition of the battery from the temperature-corrected specific gravity.

Table 2-13. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION



CORRECTED SPECIFIC GRAVITY	BATTERY CONDITION
1.280	FULLY CHARGED
1.250	THREE-FOURTH CHARGED
1.220	ONE-HALF CHARGED
1.190	ONE-FOURTH CHARGED
1.160	LITTLE USEFUL CHARGE
1.130	DISCHARGED

Figure 2-17. Hydrometer temperature correction chart.

NOTE

Perform all required clean-up and make necessary repairs before proceeding with further tests.
Replace any damaged batteries.

1. ENGINE WILL NOT CRANK. ALL ELECTRICAL SYSTEMS WEAK OR INOPERATIVE (CIRCUITS 7, 68).

Step 1. Make a visual inspection. Look for broken, cracked or distorted battery cases. Check for loose terminals. Check for corrosion on battery terminals, cables, battery holddown, and around battery posts. Check cables for frayed or worn insulation.Check electrolyte level in each cell. If level is below plates, battery may be permanently damaged. Also look for dirt, oil or other contamination floating in the electrolyte.

Replace broken, cracked or distorted batteries. Clean terminals. Tighten cables. Add distilled water to raise electrolyte level.

Step 2. Check each cell for specific gravity of battery electrolyte with hydrometer. (Refer to preliminary checks, *b* above.) Batteries must test 1.225, or greater, temperature corrected, and each cell must test within .025 gravity points of the others.

If variation is more than .025 points, charge batteries fully and recheck specific gravity on all cells. If .025-point variation still exists, one or both batteries are defective.

2. ENGINE CRANKS TOO SLOW (CIRCUITS 7, 68).

NOTE

Disconnect all battery harnesses except three 68 cables connecting the positive (+) of one battery to negative (-) of adjacent battery and perform tests in steps 1-3 below on each set of batteries as required.

Step 1. Test batteries under load to determine their ability to crank engine under starting conditions and to determine maximum voltage drop with a 100-ampere load for 15 seconds. Turn load bank switch OFF and rotate load bank control completely counterclockwise. Set voltmeter range selector switch to 50 volts. Connect circuit tester to batteries as shown in A, fig. 2-18. Turn load bank switch ON and rotate load bank knob clockwise, watching ammeter scale until 100 amperes is indicated. Voltmeter should read not less than 18 volts during test, and 24 to 26 before and after test.

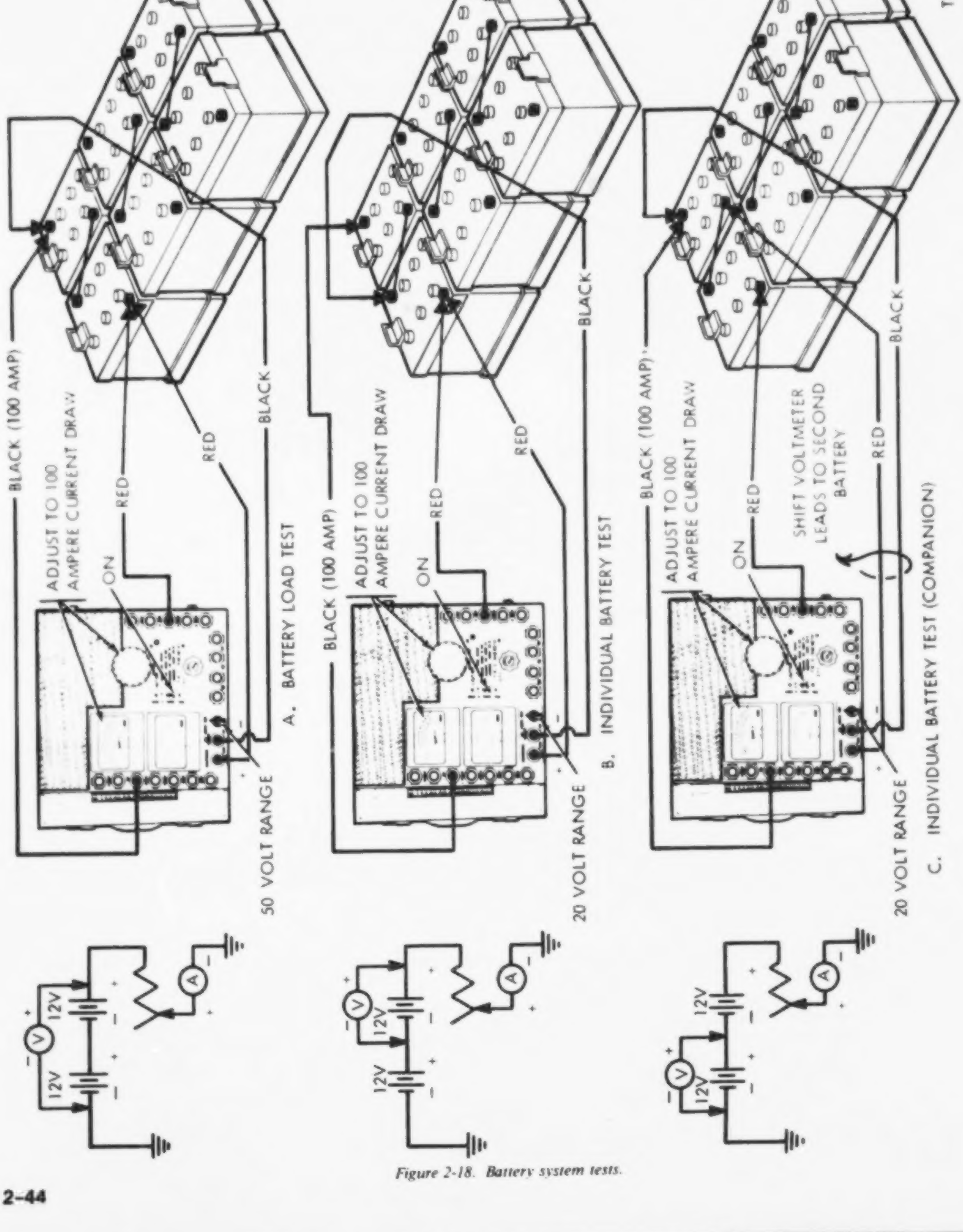
If less, perform tests in steps 2 and 3 below to test individual batteries.

NOTE

Tests in steps 2 and 3 use the same circuit tester setup as test in step 1, except that the voltmeter leads are moved to test the voltage of each individual battery.

Table 2-13. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


A. BATTERY LOAD TEST

B. INDIVIDUAL BATTERY TEST

C. INDIVIDUAL BATTERY TEST (COMPANION)

TA027489
BLACK (100 AMP)
ADJUST TO 100 AMPERE CURRENT DRAW
ON
RED
RED
BLACK
50 VOLT RANGE
BLACK (100 AMP)
ADJUST TO 100 AMPERE CURRENT DRAW
ON
RED
RED
BLACK
20 VOLT RANGE
BLACK (100 AMP)
ADJUST TO 100 AMPERE CURRENT DRAW
ON
RED
SHIFT VOLTMETER LEADS TO SECOND BATTERY
RED
BLACK
20 VOLT RANGE
12V
12V
V
A

Figure 2-18. Battery system tests.

Table 2-13. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Test individual batteries to determine maximum voltage drop with a 100 ampere load for 15 seconds, or if each has a maximum variation of ± 2 volts of the other. Turn load bank switch OFF and rotate load bank control completely counterclockwise. Set voltmeter range selector switch to 20 volts. Connect circuit tester to batteries as shown in B, fig. 2-18. Turn load bank switch ON and rotate load bank control clockwise, watching ammeter scale until 100 amperes is indicated. Voltmeter should indicate 9 volts or more. If less than 9 volts, battery is discharged or defective.

Charge battery and retest. If still less than 9 volts, replace battery (para 2-67).

Step 3. Same as step 2 (see C, fig. 2-18) on the other batteries. Voltage should not fall below 9 volts or be more than 2 volts higher or lower than the other battery.

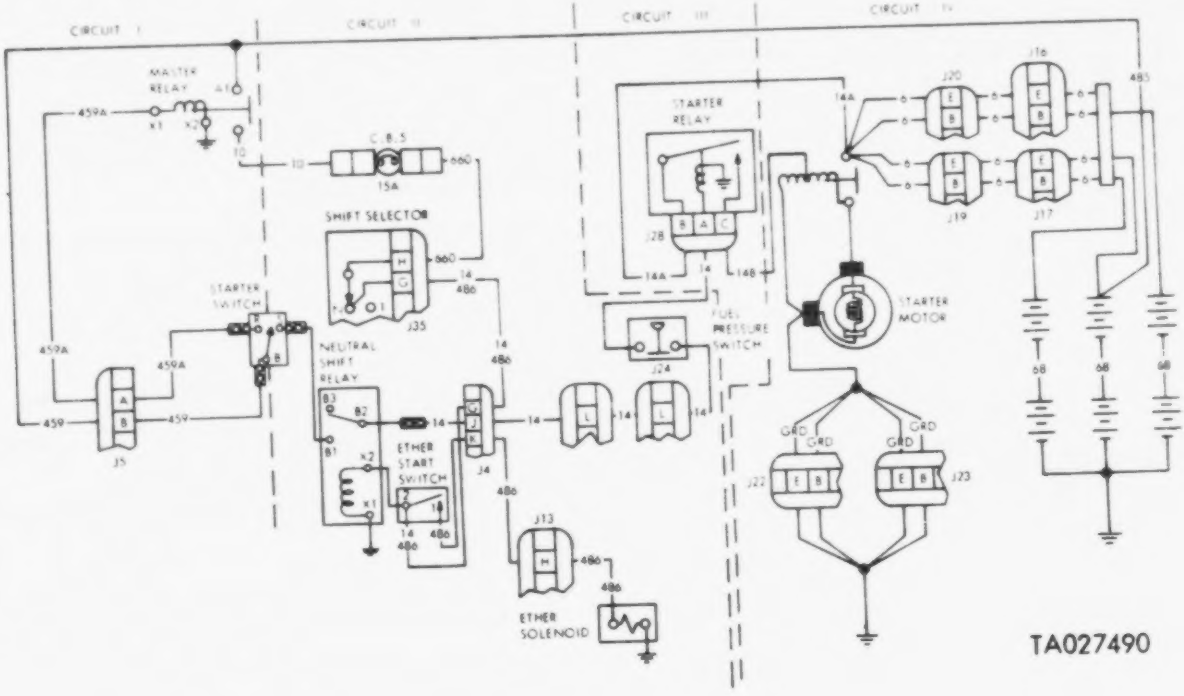
If all batteries check out normal, and engine still cranks slow, proceed to Starter Troubleshooting procedures, table 2-14.

Table 2-14. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

STARTER SYSTEM CIRCUIT

DESCRIPTION. The starter control system is divided into four individual circuits interconnected by relays (fig. 2-19). The first circuit consists of the RUN contact of starter switch and the coil of the master relay. When the starter switch is turned to the RUN position, the master relay is supplied with 24 volts by way of circuits 6, 459 and 459A. The second circuit contains the contacts of the master relay, the circuit breaker, START contacts of starter switch, fuel pressure switch, and neutral shift switch (in the transmission range selector quadrant). Current flow in this circuit is from the batteries through the contacts of the master relay, through circuit breaker CB 5, circuit 660, to the neutral shift, through circuit 14/486 to the ether start switch, and to terminal X2 of neutral switch relay. If the shift selector is in neutral, current flows from the START contact of starter switch through contacts B1 and B2 of the neutral shift relay and then through circuit 14 to the fuel pressure switch. The third circuit contains circuit wire 14, 14A, 14B, the contacts of the starter relay, and the pull-in coil of the starter solenoid (mounted on the starter assembly). The fourth circuit is composed of the heavy contacts of the starter solenoid, the starter motor, the batteries, and the heavy interconnecting cables.



CIRCUIT I
CIRCUIT II
CIRCUIT III
CIRCUIT IV
MASTER RELAY
A1
X1
X2
459A
10
C.B.5
15A
660
SHIFT SELECTOR
H
G
14
486
J35
STARTER SWITCH
NEUTRAL SHIFT RELAY
B3
B2
B1
X2
X1
ETHER START SWITCH
459
A
B
J5
J4
J13
ETHER SOLENOID
STARTER RELAY
B
A
C
J28
14A
14B
FUEL PRESSURE SWITCH
J24
L
STARTER MOTOR
J20
J16
J19
J17
E
B
485
68
GRD
J22
J23

TA027490

Figure 2-19. Starting system circuits.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Battery voltage is available to the starter switch through circuit wire 6, 485 and 459. When the switch is turned to the RUN position, contacts B and R of the switch are closed allowing current to flow through circuit wire 459A to energize the coil of the master relay. When master relay is energized, its contacts are closed applying 24 volts to circuit breaker C.B.5 and circuit wire 10. The 24 volts is then available through circuit wire 660 to the wiper of the range selector switch located in the transmission shift selector mounted in the cab of the vehicle.

When the shift selector is in the neutral position, current flows through circuit wire 14/486 to the No. 2 contact of the ether start switch. This energizes the coil of the neutral shift relay, which closes contacts B1 and B2. When the starter switch is in the START position, the circuit is complete to the fuel pressure switch. The fuel pressure switch is normally closed but will open at approximately 20 psi fuel pressure to prevent the starter from being engaged with the engine running. When the fuel switch is closed, circuit flows to energize the starter relay coil. When the starter energizes, its contacts close to allow current to flow through circuit 14A and 14B to energize the coil of the starter solenoid. When the starter solenoid is energized, the starter clutch assembly engages and the high current switches to the starter motor are closed. This allows the high cranking current to flow from the positive (+) terminal of the batteries through the starter motor to ground to crank the engine.

Failure of any one of these components or circuits, the range selector out of neutral or pressure of 20 psi in the fuel system (engine running) will prevent the starter motor from energizing. The troubleshooting procedures that follow will be divided into four parts, each part covering one of these circuits.

The ether switch is used as an aid in starting the engine when ambient temperature is below 40°F. When the spring load switch is held in the load position, the ether solenoid is energized via circuit 486. The energized solenoid allows ether to flow from the mounted storage bottle to the ether valve. Upon release of the ether switch, the solenoid is de-energized and opens the ether valve. Thus, a measured amount of ether is allowed to flow from the valve to the engine.

1. STARTER FAILS TO CRANK OR CRANKS TOO SLOWLY (CIRCUITS 6, 14, 14A, 14B, 459, 459A, 660, 486).

NOTE

If starting motor cranks too slowly or not at all, make following quick checks to assist in locating particular circuit that is defective.

Step 1. Starter switch in RUN position and instruments functioning (energized), particularly the battery-generator indicator.

Check condition of batteries (table 2-13). Service as required.

Step 2. Starter switch in RUN position and instruments not functioning.

Check condition of battery system or starter switch (table 2-13). Service as required.

Step 3. With good battery system, try to start engine and listen for heavy thump of solenoid mounted on starting motor. When thump is heard, solenoid is operating normally.

NOTE

Heavy current is needed to operate starter motor and many starter system failures can be traced to faulty cable, connector pins or sockets, loose battery and corroded ground connections.

Look for trouble in fourth circuit tests below.

Step 4. When no thump is heard, again attempt to crank engine and listen for click in starter relay which is mounted forward of starter on engine. When click is heard, relay is functioning.

Look for trouble in third circuit tests below.

Step 5. When no click is heard in starter relay, turn starter switch ON and OFF and listen for click in master relay which is mounted behind front access door. When click is heard, circuit I is functioning.

Look for trouble in second circuit tests below.

Step 6. When no click is heard in master relay, check for defective master relay or switch.

Look for trouble in first circuit tests below.

Step 7. With transmission range selector in NEUTRAL, examine starter relay and motor terminal studs, battery terminals and cables, fuel pressure switch and cables for faulty connections.

Be certain that no loose and dirty connections exist.

NOTE

Feel all battery clamps and starter solenoid and relay terminals for sensation of heat after attempting to crank engine with starter. Heat at any of these points indicates a poor connection.

I - CIRCUIT TEST

2. STARTER FAILS TO CRANK (STARTER SWITCH INOPERATIVE) (CIRCUITS 459, 459A).

Step 1. Perform starter switch test. Set up multimeter for voltage on 50 vdc. Disconnect wire 459 from starter switch. Check this wire for 24 volts. Connect red lead to wire 459 and black lead to ground (see A, fig. 2-20).

If 24 volts is not present, proceed to step 2. If 24 volts is present, reconnect and proceed to step 3.

Step 2. Disconnect J5 from panel. Set multimeter for 50 vdc. Connect red lead to J5B of harness connector, and black lead to ground. If 24 volts exist, harness between J5 and starter switch is defective.

II - CIRCUIT TEST

4. STARTER FAILS TO CRANK (CIRCUIT BREAKER DEFECTIVE) (CIRCUITS 10, 660, 14, 486).

Turn starter switch in START position. Disconnect wire 660 from circuit breaker 5. Set multimeter on 50 vdc. Connect red lead to the circuit breaker connector and black lead to ground. If 24 volts exist, proceed to malfunction 5. If 24 volts does not exist, remove wire 10 from circuit breaker. Connect red lead to wire #10.

If 24 volts exist, replace circuit breaker 5. If 24 volts does not exist, replace harness between circuit breaker and master relay. (Notify supporting maintenance.)

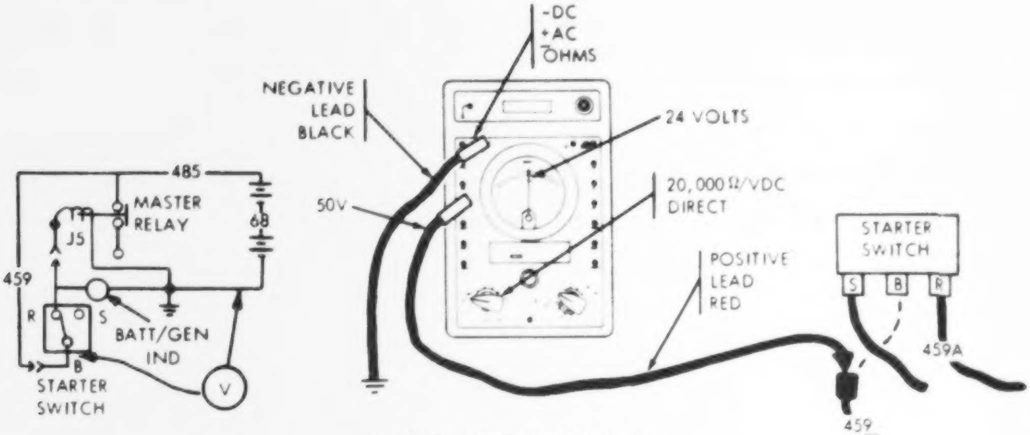
5. STARTER FAILS TO CRANK (DEFECTIVE SHIFT SELECTOR).

Step 1. Perform shift selector test. Disconnect J35 from shift selector. Set multimeter for 50 vdc. Connect red lead of the meter to harness connector J35H, and black lead to ground. If 24 volts is not present, harness between J35 and circuit breaker 5 is defective. Inspect connectors for bent or dirty contacts.

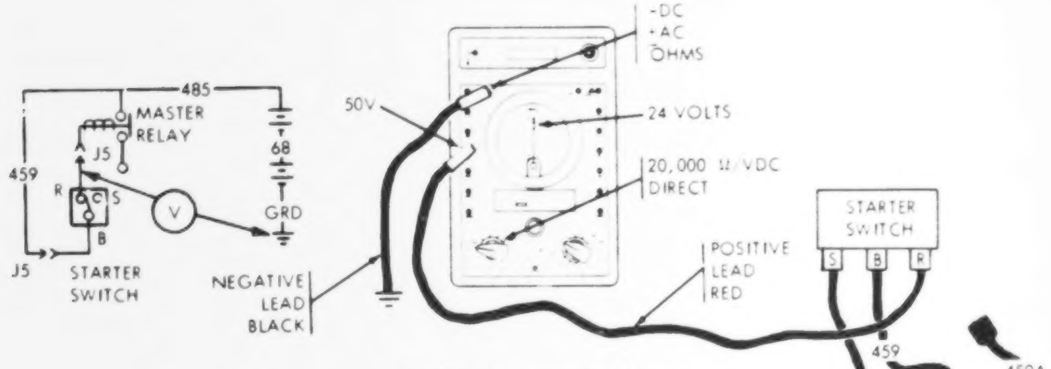
Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-14. Troubleshooting - Continued

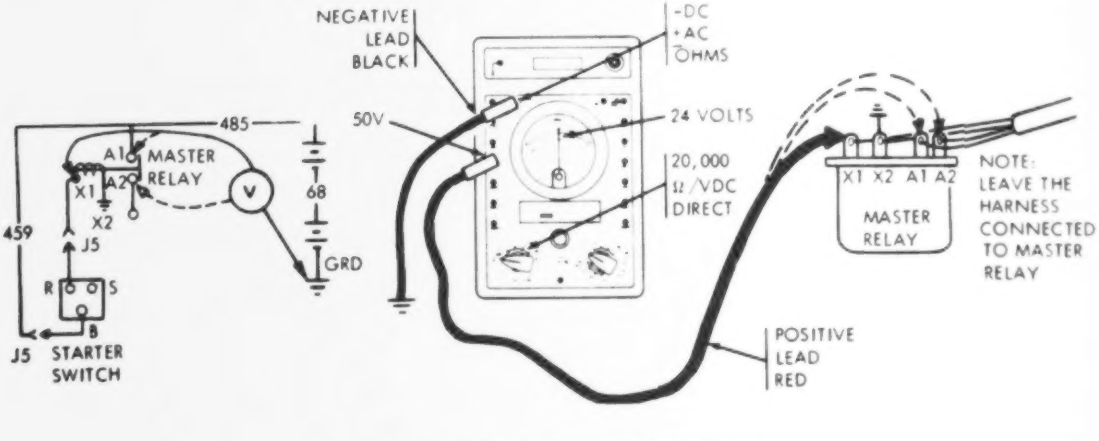
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


-DC
+AC
OHMS
NEGATIVE LEAD BLACK
24 VOLTS
50V
20,000 Ω/VDC DIRECT
485
MASTER RELAY
68
J5
459
R
S
BATT/GEN IND
B
STARTER SWITCH
V
POSITIVE LEAD RED
STARTER SWITCH
S
B
R
459A
459

A. FIRST STARTER SWITCH TEST


-DC
+AC
OHMS
50V
24 VOLTS
20,000 Ω/VDC DIRECT
485
MASTER RELAY
J5
68
459
R
S
V
GRD
B
J5
STARTER SWITCH
NEGATIVE LEAD BLACK
POSITIVE LEAD RED
STARTER SWITCH
S
B
R
459
459A

B. SECOND STARTER SWITCH TEST


NEGATIVE LEAD BLACK
-DC
+AC
OHMS
50V
24 VOLTS
20,000 Ω/VDC DIRECT
485
A1
MASTER RELAY
X1
A2
V
68
X2
J5
459
GRD
R
S
B
J5
STARTER SWITCH
X1 X2 A1 A2
MASTER RELAY
POSITIVE LEAD RED

NOTE: LEAVE THE HARNESS CONNECTED TO MASTER RELAY

C. STARTER SWITCH AND MASTER RELAY TESTS

TA027491

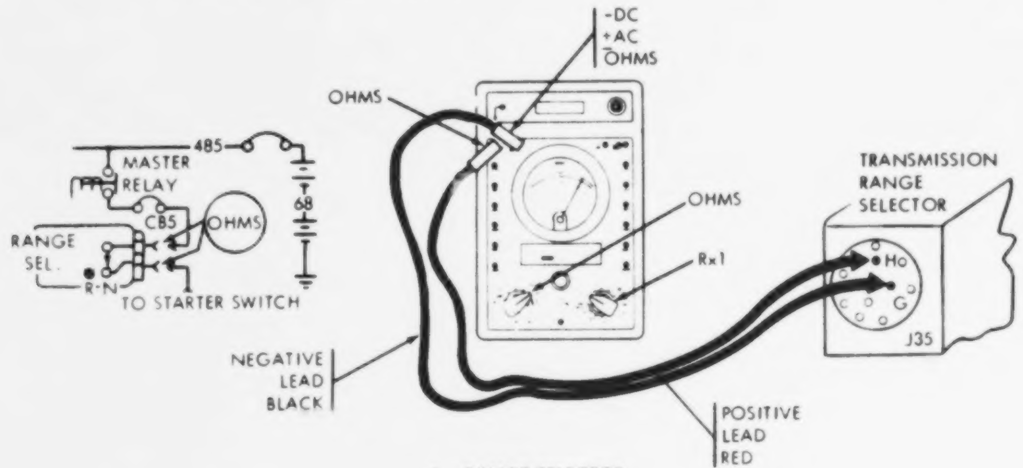
Figure 2-20. Starter switch and master relay tests.

Table 2-14. Troubleshooting - Continued

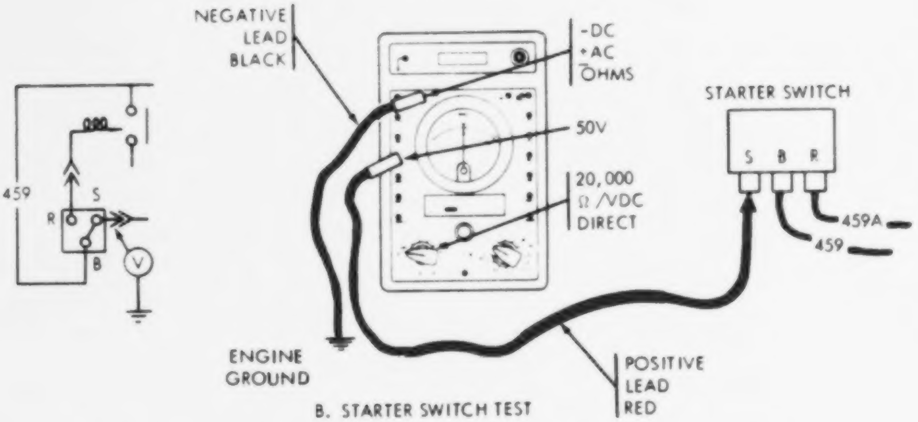
MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

Step 2. If 24 volts is present, set meter for continuity test (A, fig. 2-21). Connect red lead to J35H and black lead to J35G of the gear shift selector.

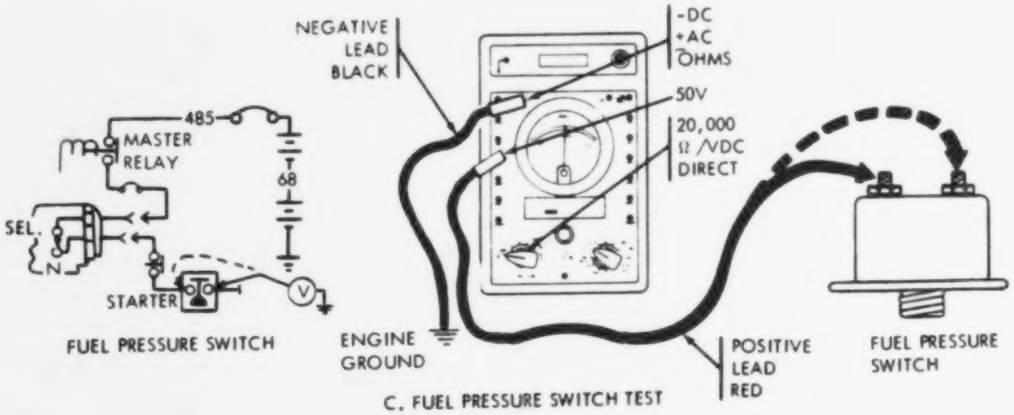
If needle deflects to right, indicating continuity when the shift lever is in neutral (N), reconnect and proceed to malfunction 6. If continuity does not exist, replace shift selector assembly (para 2-97).


-DC
+AC
OHMS
OHMS
485
MASTER
RELAY
CB5
OHMS
68
RANGE
SEL.
R-N
TO STARTER SWITCH
OHMS
Rx1
TRANSMISSION
RANGE
SELECTOR
Ho
G
J35
NEGATIVE
LEAD
BLACK
POSITIVE
LEAD
RED

A. RANGE SELECTOR


NEGATIVE
LEAD
BLACK
-DC
+AC
OHMS
STARTER SWITCH
50V
459
S
R
B
V
20,000
Ω /VDC
DIRECT
S B R
459A
459
ENGINE
GROUND
POSITIVE
LEAD
RED

B. STARTER SWITCH TEST


NEGATIVE
LEAD
BLACK
-DC
+AC
OHMS
50V
485
MASTER
RELAY
68
20,000
Ω /VDC
DIRECT
SEL.
N
STARTER
V
FUEL PRESSURE SWITCH
ENGINE
GROUND
POSITIVE
LEAD
RED
FUEL PRESSURE
SWITCH

C. FUEL PRESSURE SWITCH TEST

TA027492

Figure 2-21. Shift selector, starter switch and fuel pressure switch starter circuit tests.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance. If 24 volts is not present, check battery connections. Perform BATTERY TEST (table 2-13) to assure batteries are charged. If 24 volts is still not present, and batteries are normal, replace cable between J5 and batteries (notify supporting maintenance).

Step 3. Disconnect wire 459A from starter switch. Set multimeter to read D.C. voltage. Connect red lead to switch connector 459A, and black lead to ground (B, fig. 2-20). Place starter switch in RUN position and check for 24 volts.

If 24 volts is present, reconnect and proceed to step 4. If 24 volts is not present, replace starter switch (para 2-75c).

5. STARTER FAILS TO CRANK (MASTER RELAY DEFECTIVE) (CIRCUITS 459A, 485).

Step 1. Perform master relay test. Turn starter switch to RUN. Set multimeter for 50 vdc. Connect red lead to terminal X1 of the master relay and black lead to ground (see C, fig. 2-20). If 24 volts is not present, proceed to step 2. If 24 volts is present, connect red lead to terminals A1 and then to A2. If voltage is present at both terminals, master relay is normal, proceed to malfunction 4.

If 24 volts is not present at either of terminals, replace harness from master relay to batteries. If voltage exists on A1 and not on A2, replace defective master relay (para 2-78). Inspect for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 2. Disconnect J5 from panel. Check for continuity from harness connector to master relay. Set meter on RX1 scale, red lead to terminal X1 of master relay, and black lead to J5A of the harness connector. Needle should deflect to right indicating continuity.

If continuity exists, harness between J5 and master switch is defective, replace (para 2-65). If needle does not reflect, indicating no continuity, harness between J5 and master relay is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

6. STARTER FAILS TO CRANK (DEFECTIVE STARTER SWITCH)

Perform starter switch test. Assure shift lever is in neutral (N). Set multimeter on 50 vdc. Turn and HOLD starter switch in START position. Connect red lead to the S terminal of the starter switch, and black lead to ground (B, fig. 2-21). If 24 volts exist at S terminal, proceed to malfunction 7.

If 24 volts does not exist at the START terminal, replace starter switch. If 24 volts is not present, harness between J4 and shift quadrant connector J35 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance.

7. STARTER FAILS TO CRANK (FUEL PRESSURE SWITCH DEFECTIVE) (CIRCUIT 14)

Step 1. Perform fuel pressure switch test. Set up multimeter for DC voltage tests. Connect red test lead to one terminal of fuel pressure switch, and connect black test lead to vehicle ground as shown in (C, fig. 2-21). Set transmission range selector in neutral and turn starter switch to START position. Depress and observe meter. Move red test lead to second terminal of fuel pressure switch and repeat test. If meter indicates 24 volts at both terminals, circuit is functioning normally, proceed with test. If meter indicates 24 volts at only one terminal, fuel pressure switch is defective.

Replace switch.

If meter does not indicate 24 volts at either terminal, go to step 2. Disconnect J28 from starter relay. Set multimeter for 50 vdc and check for voltage at harness connector. Connect red lead to J28A, and black lead to ground. Assure shift selector is in neutral (N) and move starter switch to START position. If 24 volts exist, proceed to malfunction 8.

If 24 volts does not exist, harness between relay and fuel pressure switch is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 2. Place shift selector in neutral (N), and HOLD starter switch in START position for remainder of the test. Disconnect J4 fro panel. Set multimeter on RX1 scale to check continuity. Connect red lead to panel connector J4J, and black lead to panel connector J4G. If continuity exists, reconnect J4 and proceed with test.

If 24 volts is not present, harness between starter switch and J4 is defective.

Disconnect J15 from cab disconnect. Connect black lead to ground, and red lead to J15L (on connector coming from panel). If 24 volts is present, reconnect and proceed with test.

If 24 volts is not present, harness between J4 and J15 is defective.

Disconnect J24 at right engine disconnects. Connect black lead of multimeter to ground and red lead to J24L (on the connector coming from cab disconnects).

If 24 volts is present, harness between J24 and fuel pressure switch is defective. If 24 volts is not present, harness between J24 and J15 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

III - CIRCUIT TESTS

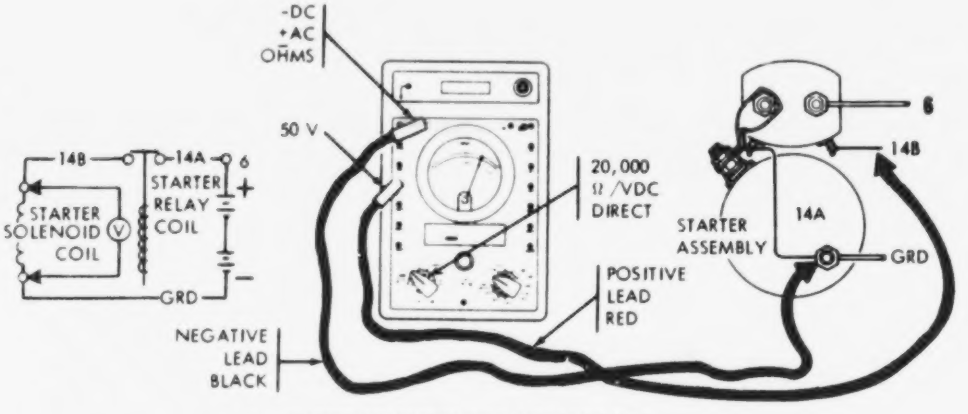
8. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW (STARTER SOLENOID FAILS TO FUNCTION) (CIRCUITS 6, 7, 10, 14, 14A, 459, 459A, 660, 666).

Perform the starter solenoid coil voltage test. Set up multimeter for voltage on 50 vdc. Connect red test lead to terminal of circuit 14B on starter solenoid and black lead to starter motor ground terminal as shown in A, fig. 2-22. Hold fuel shut-off switch in off position and turn the starter switch to START. Listen for thump of starter solenoid as it closes circuit and note voltage reading on meter. If starter solenoid closes normally and coil voltage is over 15.5 volts, starter solenoid coil circuit is operating satisfactorily. If satisfactory, then begin IV circuit tests starting with malfunction 10, step 1.

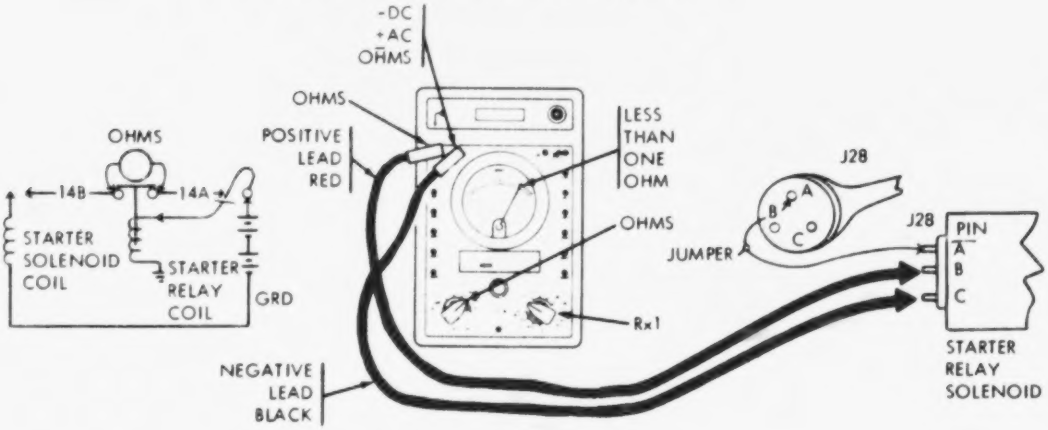
If solenoid does not close normally or it chatters, and voltage is less than 15.5 volts, go the malfunction 9. If solenoid does not close normally or chatters, but voltage is over 15.5 volts, starter solenoid or starter motor pinion assembly is defective. Replace the assembly (para 2-57).

Table 2-14. Troubleshooting - Continued

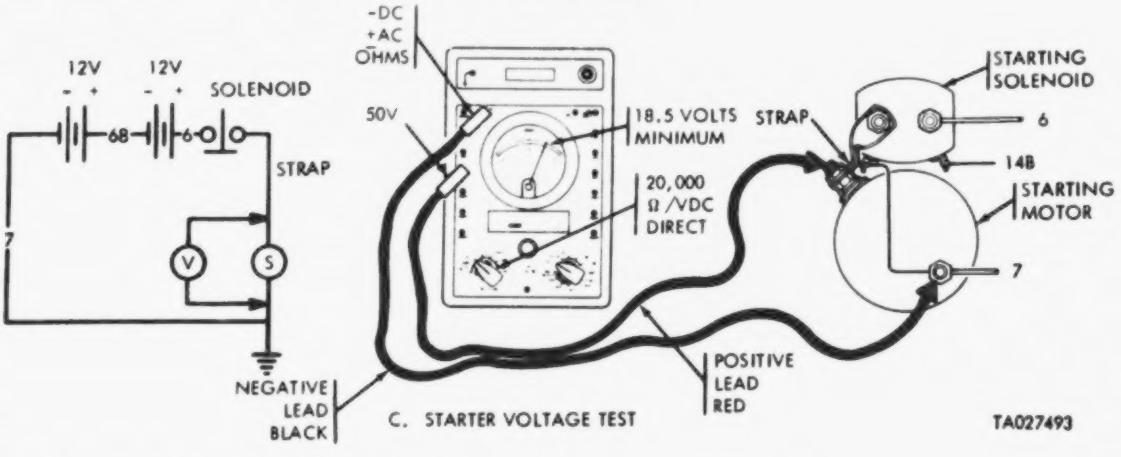
MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


-DC
+AC
OHMS
50 V
14B
14A
6
STARTER RELAY COIL
+
STARTER SOLENOID COIL
V
GRD
–
20,000 Ω /VDC DIRECT
6
14B
14A
STARTER ASSEMBLY
GRD
POSITIVE LEAD RED
NEGATIVE LEAD BLACK

A. STARTER SOLENOID COIL VOLTAGE TEST


-DC
+AC
OHMS
OHMS
POSITIVE LEAD RED
OHMS
14B
14A
STARTER SOLENOID COIL
STARTER RELAY COIL
GRD
LESS THAN ONE OHM
J28
A
B
C
OHMS
J28
JUMPER
PIN
A
B
C
Rx1
NEGATIVE LEAD BLACK
STARTER RELAY SOLENOID

B. STARTER RELAY CONTACT TEST


-DC
+AC
OHMS
12V
12V
- +
- +
SOLENOID
6B
6
STRAP
7
V
S
50V
18.5 VOLTS MINIMUM
20,000 Ω /VDC DIRECT
STRAP
STARTING SOLENOID
6
14B
STARTING MOTOR
7
POSITIVE LEAD RED
NEGATIVE LEAD BLACK
TA027493

C. STARTER VOLTAGE TEST

Figure 2-22. Starter and starter coil voltage test and starter relay contact test.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

9. ENGINE FAILS TO CRANK (STARTER RELAY DEFECTIVE) (CIRCUITS 14, 14A, 14B).

Hold fuel shutoff switch in the OFF position and turn starter switch to START. Listen for click of the starter relay solenoid. If no click is heard, replace the starter relay. If chatter is heard, verify batteries and cables are operational. If a click is heard, proceed with test. Disconnect J28 from relay. Connect a jumper wire from J28A of connector to J28A of relay (B, fig. 2-22). Set the multimeter to read resistance, on RX1 scale. Connect red lead to J28B and black lead to J28C of relay connector. Turn starter switch to START. The needle should deflect to indicate a closed circuit (less than 1 ohm).

If meter indicates more than 1 ohm, replace starter relay. If less than one ohm, harness between starter relay is defective. Check all terminals on starter motor relay for dirt or corrosion. If terminals are clean and tight, and engine still won't crank, or is weak, proceed to malfunction 14. If multimeter indicates more than 1 ohm, replace starter relay. If multimeter indicates less than 1 ohm, replace starter relay harness. Also, inspect and make necessary repairs to dirty or corrosive terminals. If terminals are clean and tight and engine still does not crank, or is weak, proceed to malfunction 14.

IV - CIRCUIT TESTS

10. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW.

Step 1. Perform starter voltage test. Connect multimeter, set up for 50 vdc, between positive (+) starter terminals and negative (-) starter terminal, as shown in C, fig. 2-22. Hold fuel cut-off switch in OFF position and turn starter switch to crank engine. If meter indicates 18.5 volts or more, starter solenoid, cables and batteries are not the cause of slow cranking.

Remove starter (para 2-57) and check for tightness of flywheel ring gear. If ring gear is free, replace starter. However, if voltage indicated at starter is less than 18.5 volts, go to step 2.

Step 2. Perform battery negative cable test. Connect multimeter, set up for 50 vdc, between one negative battery terminal and starter negative terminal clamp as shown in A, fig. 2-23. Hold fuel cut-off switch and crank engine with starter switch. If voltmeter shows no or low reading, change to a lower range until a reading is obtained or 2.5 volt range is reached.

If reading is more than 0.8 volt, remove and clean battery negative cables and battery terminal post clamps with wire brush. Reinstall battery cables and terminal post clamps, tighten all bolts securely to assure good electrical connection. Repeat battery negative cable test and if voltage reading is still more than 0.8 volt, disconnect cabies at engine connector. Disassemble both halves of connector, inspect, clean both halves, reassemble both halves and connect tightly. Repeat battery negative cable test and if voltage is still more than 0.8 volt, replace complete cable assemblies. If starter still cranks slowly, go the malfunction 11.

11. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW (VOLTAGE LOSS) (CIRCUIT 68).

Perform battery-to-battery cable test. Connect the voltmeter (50-volt jack) across battery-to-battery cable. Make contact with the actual battery posts but not terminal post clamp, with positive and negative test leads as shown in B, fig. 2-23. Hold fuel cut-off switch in OFF position and turn starter switch to START to crank engine. If voltmeter shows no or low reading, change voltmeter range jack to a lower range until a reading is obtained or 1-volt range is reached. If reading is 0.1 volt or less, cable is serviceable.

If reading is 0.1 volt or more, remove battery-to-battery cable. Clean both battery terminal posts and terminal post clamps on cable with wire brush. Reinstall cable and tighten all bolts securely to assure a good electrical connection. Perform test again. If voltage is still more than 0.1 volt, install a new cable, and retest. Repeat test on other two battery-to-battery cables. If starter continues to crank too slowly, go to malfunction 12.

12. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW (VOLTAGE LOSS) (CIRCUIT 6).

Perform battery positive terminal test. Connect voltmeter set up for 50 vdc between battery positive post and its terminal post clamp as shown in A, fig. 2-24. Hold engine fuel cut-off switch in OFF position and crank engine with starter switch. If voltmeter shows no or low reading, switch voltmeter selector to a lower range until a reading is obtained or 1 volt is reached.

If reading is more than 0.1 volt, remove battery positive terminal post clamp and clean terminal post and post clamp with a wire brush. Reinstall cable and tighten all bolts securely to assure a good electrical connection. Perform test again. If voltage is still more than 0.1 volt, install a new terminal, post clamp and retest. Repeat battery positive terminal test for all three positive battery posts. If starter still cranks slowly, go to malfunction 13.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

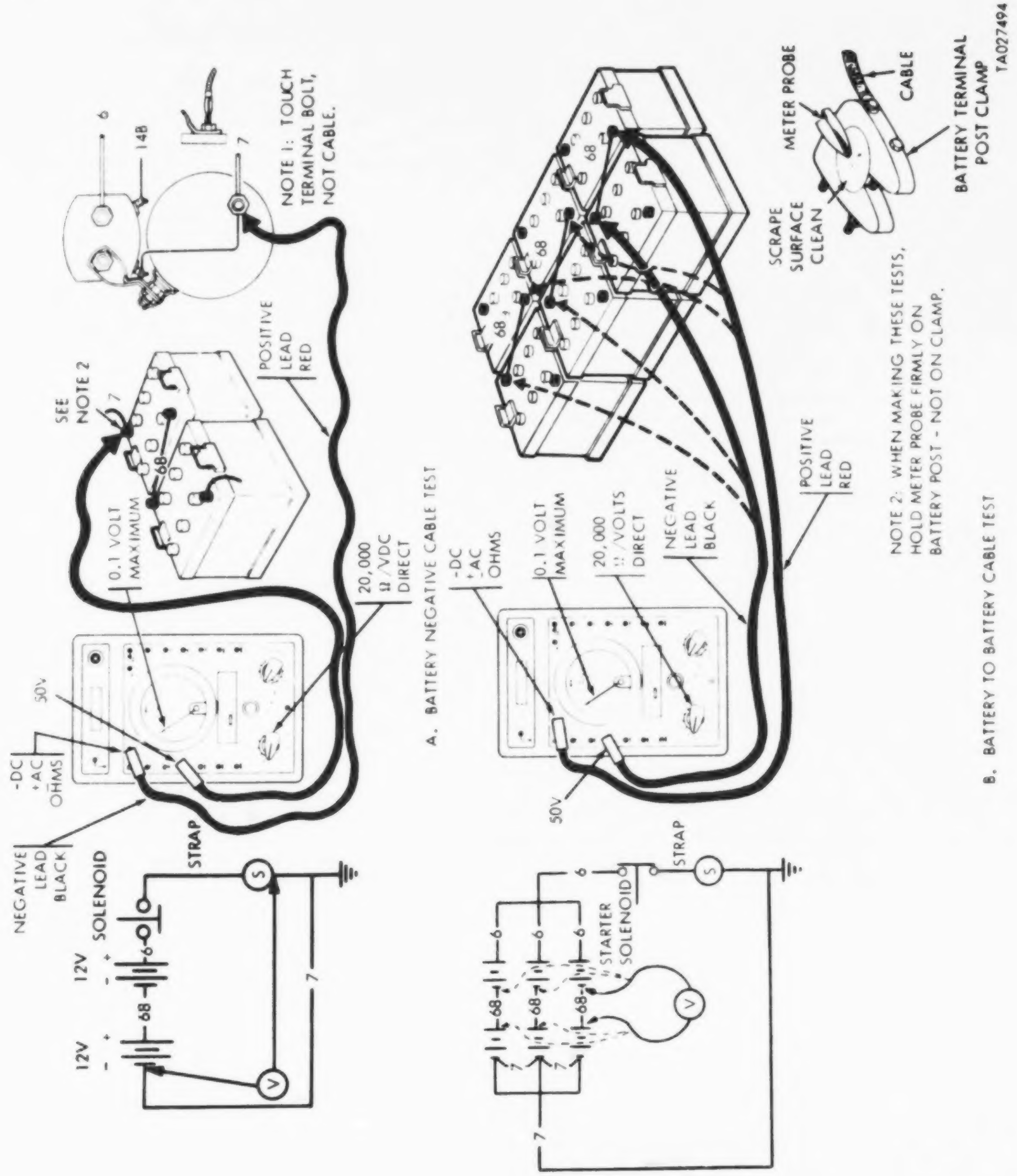
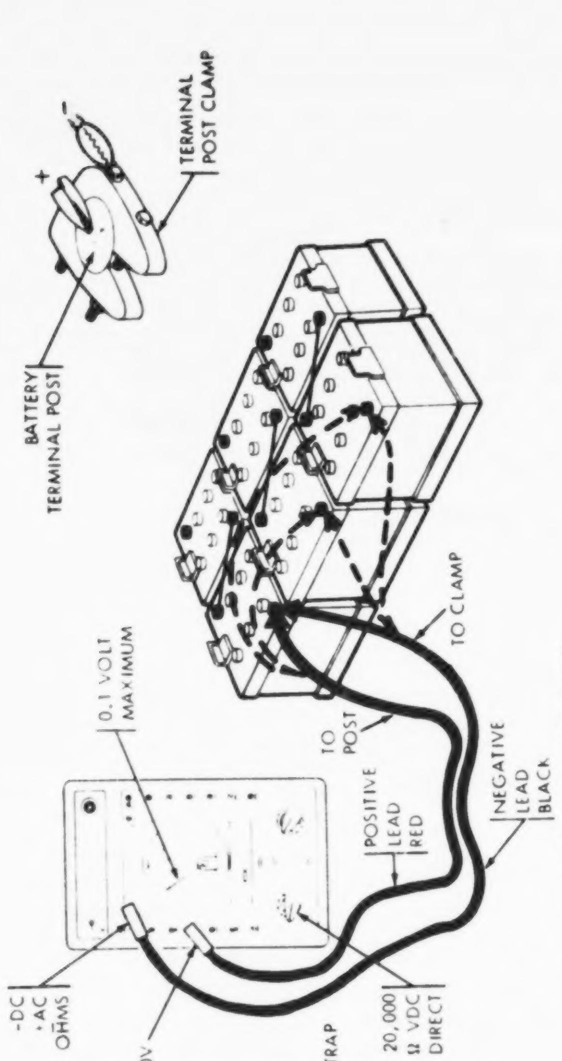

NEGATIVE LEAD BLACK
-DC +AC OHMS
50V
0.1 VOLT MAXIMUM
20,000 Ω /VDC DIRECT
SEE NOTE 2
7
68
POSITIVE LEAD RED
6
148
7
NOTE 1: TOUCH TERMINAL BOLT, NOT CABLE.
12V
12V
SOLENOID
68
6
7
STRAP
S
V
A. BATTERY NEGATIVE CABLE TEST
-DC +AC OHMS
0.1 VOLT MAXIMUM
20,000 Ω /VOLTS DIRECT
NEGATIVE LEAD BLACK
POSITIVE LEAD RED
50V
68
6
7
STARTER SOLENOID
STRAP
S
V
NOTE 2: WHEN MAKING THESE TESTS, HOLD METER PROBE FIRMLY ON BATTERY POST - NOT ON CLAMP.
SCRAPE SURFACE CLEAN
METER PROBE
CABLE
BATTERY TERMINAL POST CLAMP
TA027494
B. BATTERY TO BATTERY CABLE TEST

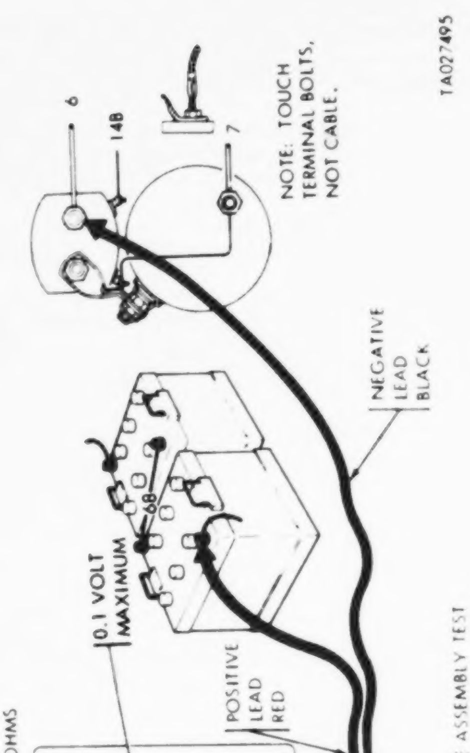
Figure 2-23. Battery negative cable test and battery to battery cable test.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


BATTERY TERMINAL POST
TERMINAL POST CLAMP
+
-
0.1 VOLT MAXIMUM
TO CLAMP
TO POST
POSITIVE LEAD RED
NEGATIVE LEAD BLACK
-DC +AC OHMS
50V
20,000 Ω VDC DIRECT
STRAP
STARTER SOLENOID
S
V
6
68
7

A. BATTERY POSITIVE TERMINAL TEST


TA027495
6
148
7
NOTE: TOUCH TERMINAL BOLTS, NOT CABLE.
NEGATIVE LEAD BLACK
0.1 VOLT MAXIMUM
68
POSITIVE LEAD RED
-DC +AC OHMS
50V
20,000 Ω VOLTS DIRECT
STRAP
STARTER SOLENOID
S
V
6
68
7

B. POSITIVE CABLE ASSEMBLY TEST

Figure 2-24. Battery positive terminal and cable tests.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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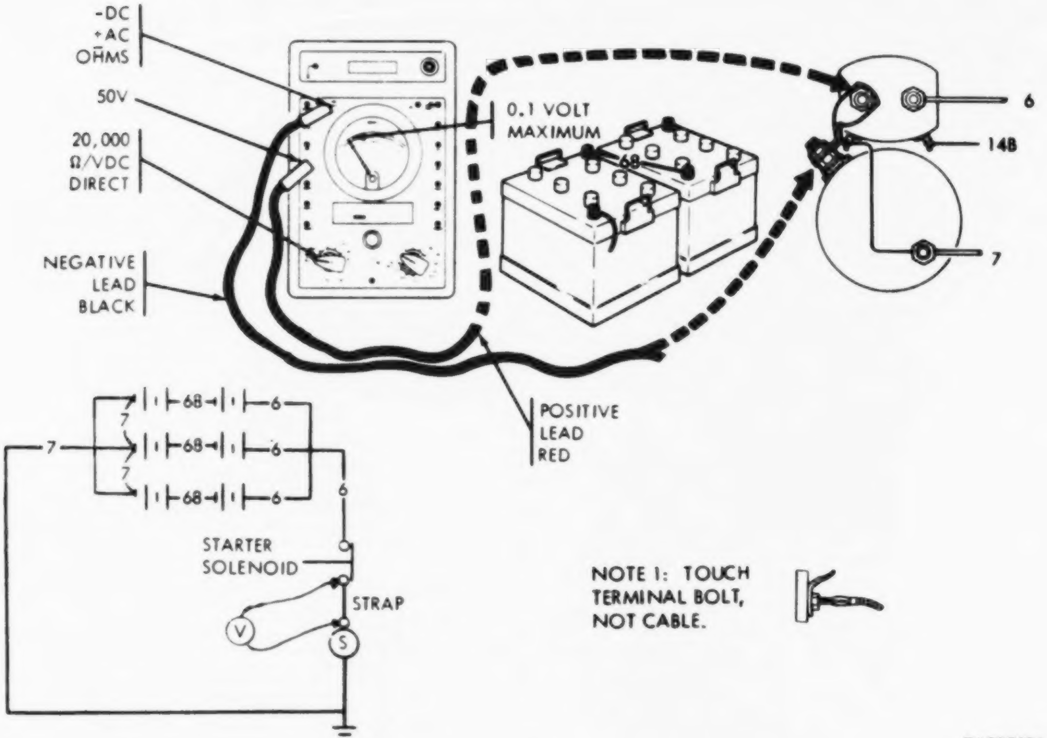
13. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW (VOLTAGE LOSS) (STRAP).

Perform solenoid-to-starter strap test. Connect voltmeter set up for 50 vdc between solenoid terminal bolt and stater terminal bolt, as shown in A, fig. 2-25. Hold fuel cut-off switch in OFF position and crank engine with starter switch. If voltmeter shows no or low reading, switch range selector until a reading is obtained.

If reading is 0.1 volt or more, remove strap and clean both ends and both terminal bolts thoroughly with a wire brush. Reinstall strap and tighten terminal nuts tightly to make a good electrical connection. If starter continues to crank slowly, go to malfunction 14.



TA027496

Figure 2-25. Starter solenoid strap and contact tests.

14. ENGINE FAILS TO CRANK OR CRANKS TOO SLOW (VOLTAGE LOSS).

Perform battery positive cable assembly test. Connect voltmeter set up for 50 vdc between battery positive post and starter solenoid terminal post marked BAT as shown in B, fig. 2-24. Hold fuel cut-off switch in OFF position and crank engine with starter switch. If voltmeter shows no or low reading, change to a lower range until a reading is obtained or 2.5 volt range is reached. If reading is more than 0.8 volt, disconnect connectors 19 and 20 at engine electrical connector panel.

Disassemble both halves of each connector and clean. Inspect for and repair any damage. Reassemble connector and tightly reconnect them to assure good electrical contact and repeat battery positive cable assembly test. If voltage is still more than 0.8 volt, disconnect, clean and inspect connectors 16 and 17 at cab disconnect point. Repair any damage and reconnect to assure good electrical contact. Again repeat battery positive cable assembly test. If voltage is still more than 0.8 volt, install new cables. If voltage is less than 0.8 volt, or if starter still cranks slowly after cables have been replaced, replace starter motor assembly (para 2-57).

15. STARTER CRANKS CONTINUOUSLY.

CAUTION

If starter cranks continuously or cranks when starter switch is turned to RUN, disconnect batteries before troubleshooting.

Replace starter motor assembly (para 2-57).

16. ENGINE CRANKS O.K. ENGINE WILL NOT START IN COLD WEATHER (ETHER KIT MALFUNCTIONING) (CIRCUITS 486, GROUND).

WARNING

Ether fumes are extremely flammable. Perform tests in well ventilated area away from extreme heat or flames.

Table 2-14. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

Step 1. Check ether injection lines for any damage, bends, or kinks. Assure ether bottle is not empty and tightly (hand tight) secured into either valve. Assure gear shift is in neutral (N). Turn starter switch to RUN. Observe ether valve/solenoid linkage (fig. 2-69) at bottom of valve assembly during next step. Hold ether switch in inject position. The valve/solenoid linkage should move indicating the solenoid was energized. Release ether switch. The linkage should now return to its normal position.

If linkage operates as described above, perform ether kit test (para 2-46*a*). If linkage does not move as described, proceed to step 2.

Step 2. Set up multimeter to check voltage on 50 vdc scale. Connect red lead to ether solenoid terminal which wire 486 is connected. Connect black lead to ground. Hold ether switch in inject position.

If 24 volts is present on meter, replace defective solenoid. If 24 volts is not present, proceed to step 3.

Step 3. Connect red lead of multimeter to one of terminals on rear of ether switch. Connect black lead to ground. Hold ether switch in load position. Observe meter for any voltage reading. With switch still in load position, place red lead of the meter on other terminal of ether switch.

If 24 volts are present on both terminals, proceed to step 4. If 24 volts exist on only one terminal, replace defective ether switch (para 2-75*c*). If 24 volts is not present on either terminal, replace jumper wire from starter switch to terminal of ether switch.

Step 4. Hold ether switch in load position for remainder of test. Disconnect J13 from cab disconnect. Connect red lead of multimeter to J13H (connector on harness going towards panel) and black lead to ground. If 24 volts is present on meter, harness between J13 and ether solenoid is defective. If 24 volts is not present, turn starter switch OFF and release ether switch. Set up multimeter to check continuity of RX1 scale. Disconnect J4 from panel. Connect red lead of meter to J13H (connect on harness going towards panel) and black lead to J4K (harness connector). If continuity exists, harness between J4 and ether switch is defective. If continuity does not exist, harness between J4 and J13 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-15. Troubleshooting

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

TRANSMISSION RANGE SELECTOR

DESCRIPTION. The transmission is a power shift transmission in which the range selection is accomplished electrically. The electric shift control system consists of the gear range selector, the hydraulic range selector valve assembly mounted on the right rear of the transmission housing and an interconnecting cable (fig. 2-26). The range selector is composed of the main housing, shift lever (which is detented and gated for positive selector control), the electric tap switch assembly (which is synchronized to the shift lever) and the cable connector. The tap switch is a multiple tap rotary switch with the terminal taps so located that the lever range position coincides with the proper circuit closing position to the range valve solenoid. The hy-

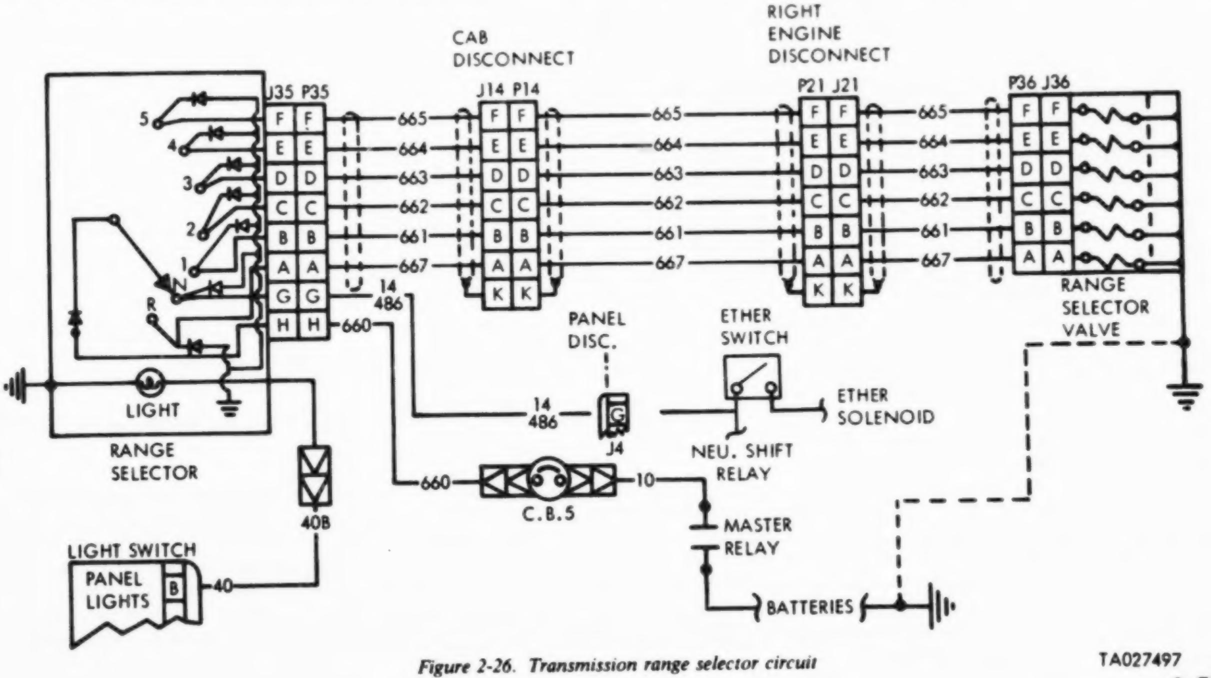


Figure 2-26. Transmission range selector circuit

TA027497

Table 2-15. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

draulic range selector valve assembly is composed of a range selector valve body (containing six solenoid controlled range valves with necessary hydraulic oil passages), six 24-volt DC solenoids, a junction box to cover the solenoids, the connecting fittings and the electrical control cable. Only one solenoid is energized at any gven time to provide operating oil pressure for desired range clutch in the transmission.

1. STARTER FAILS TO CRANK (CIRCUITS 6, 7, 68, 660, 666).

    Refer to Starter troubleshooting in table 2-14.

2. NO RANGE SHIFT POSSIBLE (ALL RANGES) (ENGINE STARTS NORMALLY) (CIRCUITS 661, 662, 663, 664, 665, 667).

    Visually check for loose, damaged or dirty connections at range selector valve, engine disconnect panel and cab disconnect or shift control cable (fig. 2-26).

    Make any repairs necessary, tighten all conectors to insure good electrical connection and recheck. If no range is possible, go to malfunction 3, step 1.

3. NO RANGE SHIFT POSSIBLE (ALL RANGES) (ENGINE STARTS NORMALLY).

    Step 1.

    a. Range selector valve voltages. Disconnect control cable at selector valve at rear of transmission. With multimeter set up for 50 volts dc, connect red test lead to pin A of cable connector and black lead to vehicle ground. Turn starter switch to RUN and shift range selector to reverse (R).
    b. If meter indicates 24 volts, circuit is normal. Check all other pins to assure 0 volts exist.
    c. If 24 volts exist at more than one pin, continue the test to find defect. Repeat test for other ranges (see Chart 1 for pin/range connections).
    d. If meter indicates 24 volts at only pins indicated, trouble is in transmission or selector valve assembly.
        Report trouble to support maintenance shop.
    e. If meter does not indicate 24 volts at any of pins, or more than one pin for each gear selected, repeat step 1 at engine disconnect plug J21.
    f. If meter indicates 24 volts only on specified ranges, engine harness J21-P36 is defective.
        Visually inspect harness and both connectors for damage, loose or dirty contacts. Make necessary repairs or notify support personnel.
    g. If 24 volts is not available at the engine disconnect plug, repeat step 1 at vehicle cab disconnect, J15.
    h. If 24 volts is available on all pins indicated, harness between P-12 and P-21 is defective.
        Visually inspect harness and connectors for damage, loose or dirty contacts. Make necessary repairs or replace harness.
    i. If 24 volts is still not available, go to step 2.

	Connector Pin	
Selector range	*Selector*	*Harness*
Reverse	A	A
1st	B	B
2nd	C	C
3rd	D	D
4th	E	E
5th	F	F
Neutral	G	-
Center Tap	H	-

CHART 1

Step 2. Range selector continuity test. Disconnect control harness from shift selector connector. With multimeter set up to indicate resistance (zeroed on RX1 scale), connect one test lead to position H on selector connector. Connect second test lead to position G on selector connector and shift into N (neutral). The meter needle should indicate swing to right edge of scale and indicate zero. Leaving first lead connected to position H, move second lead to positions A through F and repeat test for R through 5th range (see Chart 1). If meter indicates more than zero on any position, or if needle deflects at any position of shift lever than one being checked, shift selector is defective.

Replace shift selector assembly (para 2-97). If meter indicates zero at all positions and needle does not deflect any any position than one being checked, gear shift is functioning normally.

4. ONE OR MORE BUT NOT ALL RANGE SELECTIONS NOT FUNCTIONING (CIRCUITS 661, 662, 663, 664, 665, 667).

    Step 1. Range selector continuity test.

    Go to Malfunction 3, step 2 for range not functioning (see Chart 1). If shift selector is functioning normally, reconnect harness and proceed to step 2 below.

    Step 2. Range selector valve voltages.

    Go to Malfunction 3, step 1 at control valve connector for range not functioning. If meter indicates 24 volts, go to malfunction 5. If meter indicates less than 24 volts, continue with malfunction 3, step 1 to isolate trouble.

5. ONE OR MORE BUT NOT ALL RANGE SELECTIONS NOT FUNCTIONING (CIRCUITS 661, 662, 663, 664, 665, 667).

    Step 1. Shift solenoid continuity test. Set up multimeter to measure resistance on RX1 scale. Disconnect harness connector at range selector valve assembly J36. Connect black test lead to vehicle ground and connect red test lead to position on valve assembly connector J36 corresponding to range being checked (see Chart 1). If meter indicates 50-60 ohms solenoid is functioning properly.

    If meter indicates more than 60 ohms, go to step 2 below. If meter indicates less than 50 ohms, notify support personnel to replace solenoid.

Table 2-15. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Solenoid valve coil resistance. Remove cover plate from connector junction box (six bolts) and disconnect wire going to range solenoid from connector (see Chart 2 for solenoid identification). With multimeter set to measure resistance on RX1 scale, connect black lead to vehicle ground and red lead to connector on solenoid. If meter indicates 50-60 ohms, solenoid is good.

Look for dirty connection or damaged wire from solenoid to junction box connector. If none is found, trouble is in selector valve assembly. Notify support personnel. If meter is greater than 60 ohms, solenoid is defective. Notify support personnel.

Range	Solenoid ident. letter
Reverse	C or W
1st	D or X
2nd	B or V
3rd	F or Z
4th	A or T
5th	E or Y

Identification letter stamped on side of range selector valve.

Chart 2

6. JUMPS OUT OF RANGE SELECTION (CIRCUITS 661, 662, 663, 664, 665, 667).

Perform quick checks to locate loose connectors, dirty connections or damaged wiring harness.

If none are found, go to malfunction 3, step 1 to locate an intermittent connection. Repair or replace as necessary. Go to malfunction 3, step 2 to locate intermittent contact in range selector. Replace range selector if necessary (para 2-97).

7. SHIFT SELECTOR HANDLE DOES NOT AGREE WITH RANGE SELECTED.

Step 1. Go to malfunction 3, step 2.

Replace range selector if necessary (para 2-97).

Step 2. If shift selector is normal, go to malfunction 3, step 1.

Table 2-16. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

GAGES AND SENDING UNITS

DESCRIPTION: Gages indicate transmission oil temperature, engine oil pressure, engine coolant temperature, battery/gen condition and fuel level (fig. 2-27). The battery/gen gage is connected directly to the batteries. It indicates an uncharged, normally charged or overcharged condition of the batteries.

There are two components to the other gage systems, the mounted gage and the sending unit. The sending unit is near or in the medium it is measuring. A change in temperature, pressure or level changes the resistance in the sending units. This change in resistance causes a calibrated needle deflection in the mounted gage.

1. ALL GAGES ARE INOPERATIVE (CIRCUIT 27).

Assure starter is in RUN position.

Step 1. Disconnect wire No. 10 from C.B.1. Set multimeter for 50 vdc. Connect red lead to wire No. 10 and black lead to vehicle ground. 24 volts should be present here. If 24 volts is present, reconnect and go to step 2.

If no voltage is present, see troubleshooting the starter circuit, malfunction 3, step 1. If 24 volts are present on both terminals (A1, A2), repair defective harness between master relay and C.B.1. If defect cannot be corrected by minor repair, notify support personnel.

Step 2. Disconnect wire No. 27 from C.B.1. With the multimeter set for 50 vdc, connect black lead to ground and red lead to circuit breaker terminal from which wire No. 27 was removed.

If 24 volts are not present, replace defective circuit breaker. If 24 volts are present, proceed to step 3.

Step 3. Disconnect connector J1 from panel. Check for continuity with multimeter set on RX1 scale from J1F (harness connector) to wire No. 27 from C.B.1.

If continuity exists, harness from panel connector J1 to gages is defective. If continuity does not exist, harness between panel connector J1 and circuit breaker #1 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance.

2. BATTERY/GENERATOR INDICATOR MALFUNCTIONING. ALL OTHER GAGES OPERATIVE (CIRCUIT 27).

Assure starter switch is in RUN position. Disconnect wire No. 27 from the malfunctioning gage. With multimeter set for 50 vdc, connect black lead to vehicle ground and red lead to wire No. 27.

If 24 volts is present, replace defective gage (para 2-74*a*(5)). If 24 volts are not present, harness between gage and panel is defective. Inspect harness and connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-16. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

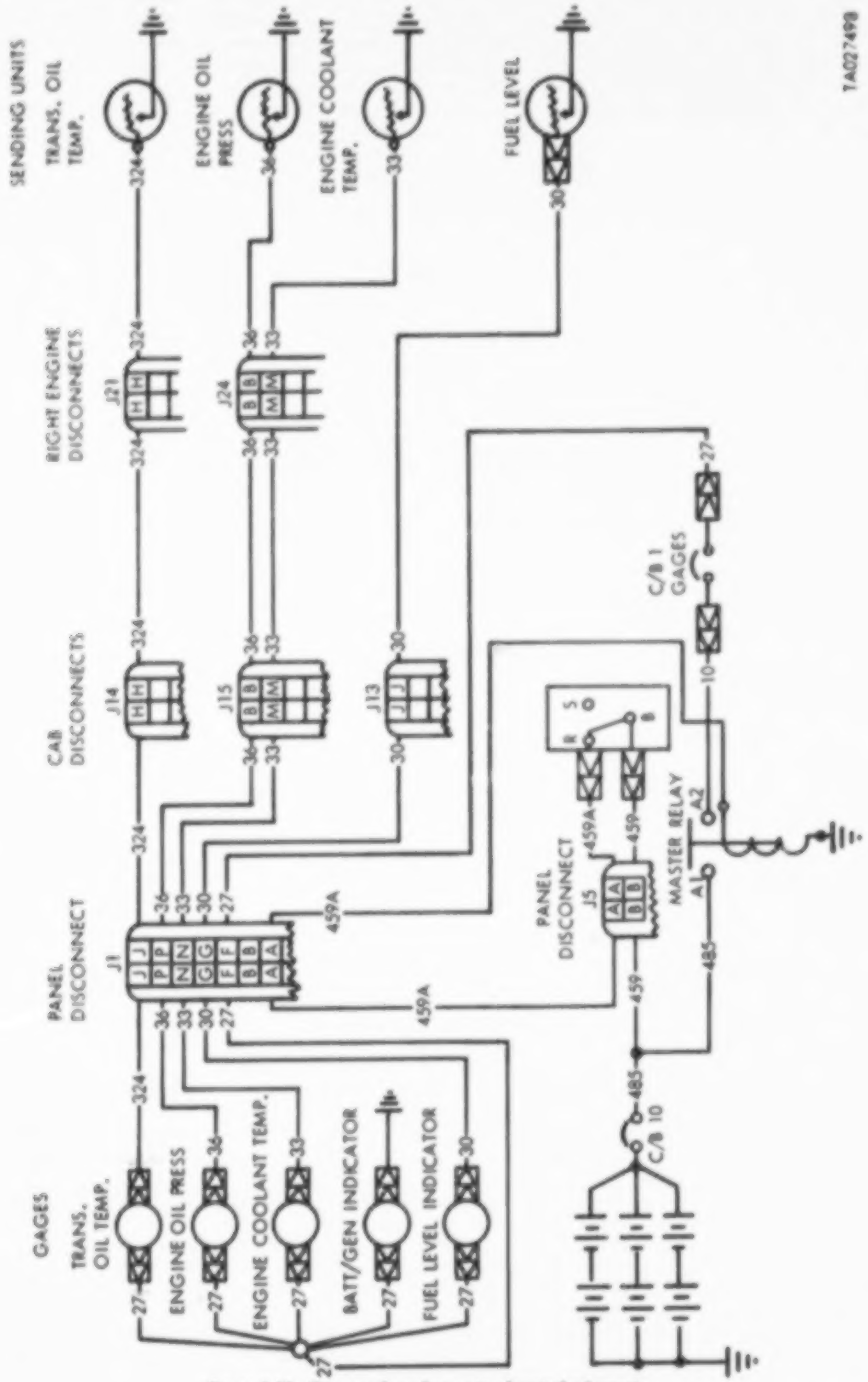

SENDING UNITS
TRANS. OIL TEMP.
ENGINE OIL PRESS
ENGINE COOLANT TEMP.
FUEL LEVEL
RIGHT ENGINE DISCONNECTS
J21
J24
CAB DISCONNECTS
J14
J15
J13
PANEL DISCONNECT
J1
PANEL DISCONNECT
J5
C/B 1 GAGES
MASTER RELAY
A1
A2
R
S
B
C/B 10
GAGES
TRANS. OIL TEMP.
ENGINE OIL PRESS
ENGINE COOLANT TEMP.
BATT/GEN INDICATOR
FUEL LEVEL INDICATOR
324
36
33
30
27
459A
459
485
10
TA027498

Figure 2-27. Gages and sending units electrical schematic

Table 2-16. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

3. ONE OF THE GAGES IS MALFUNCTIONING. ALL OTHER GAGES OPERATIVE (CIRCUITS 27, 324, 36, 33, 30)

Step 1. Assure starter switch is in RUN. Disconnect wire No. 27 from malfunctioning gage. With a multimeter set for 50 vdc, check for 24 volts from wire No. 27. Connect black lead to ground and red lead to wire No. 27.

If 24 volts is available, reconnect wire No. 27 and proceed to step 2. If 24 volts is not present, replace harness between J1 and gage.

Step 2. Disconnect specified connectors of malfunctioning gage. Check with multimeter set on appropriate scale for specified resistance. Connect red lead to harness connector which was disconnected from gage, and black lead to ground (Chart 3).

Gage	*Connectors (red lead)*	*Resistance*	*Conditions*
Trans. Oil Temp.	Wire 324	300-3,000 Ω	Trans. must be at normal operating temp.
Engine Oil Pres.	Wire 36	3-12 Ω	Engine idling.
Engine Cool Temp.	Wire 33	500-3,000 Ω	Engine must be at normal operating temp.
Fuel Level Ind.	Wire 30	5-35 Ω	Tanks must be at least ¼ full.

Chart 3

If specified resistance is present, replace malfunctioning gage (para 2-74a). If resistance is not present, proceed to step 3.

Step 3. Disconnect connector from related sending unit (fig. 2-27). Check for specified resistance from terminal of sending unit to vehicle ground (Chart 4).

Sending Unit	*Resistance*	*Conditions*
Trans. Oil Temp.	300-3,000 Ω	Trans. at normal operating temp.
Engine Oil Pres.	3-12 Ω	Engine idling.
Engine Coolant Temp.	500-3,000 Ω	Engine at normal operating temp.
Fuel Level Ind.	5-35 Ω	Tanks must be at least ¼ full.

Chart 4

If resistance is present, reconnect wire to sending unit. Proceed to step 4. If not, replace sending unit.

Step 4. Disconnect the engine connector specified in Chart 5 and check for resistance as shown. If resistance is present, check cab connectors and then panel connectors. In all cases, connect black lead to ground and red lead to the specified connector coming back from engine.

If resistance is not present at engine connector, harness between connector tested and sending unit is defective.* If resistance is not present at cab disconnect, harness between cab connector tested and engine connector is defective.* If resistance is not present at panel connector, harness between J1 and cab disconnect is defective.* If resistance is present at all connectors, harness between J1 and gages is defective.*

Inoperative gage	*Right Eng connector*	*Cab connector*	*Panel connector*	*Resistance*	*Conditions*
Transmission Oil Temp.	J21H	J14H	J1J	300-3,000 Ω	Transmission at normal operating temp.
Engine Oil Pressure	J24B	J15B	J1P	3-12 Ω	Engine idling.
Engine Cool and Temp.	J24M	J15M	J1N	500-3,000 Ω	Engine at normal operating temp.
Fuel Level**		J13J	J1G	5-35 Ω	Fuel tanks at least ¼ full.

Chart 5

*Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.
**If resistance is not present at cab connector, harness between J13 and sending unit is defective.*

4. TRANSMISSION OIL TEMP GAGE NOT INDICATING CORRECT TEMPERATURE (CIRCUIT 324).

Interchange transmission oil temperature sending unit with engine coolant temp. (fig. 2-81) sending unit.

If gage is still indicating incorrect temperature, replace defective gage. If gage indicates correct temperature, replace defective sending unit (para 2-61). Replace sending unit which was switched to engine coolant temp. sending unit.

Table 2-16. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

5. ENGINE COOLANT TEMP. GAGE NOT INDICATING CORRECT TEMPERATURE (CIRCUIT 33).
    Interchange sending units as in malfunction 4.
        If gage is still indicating incorrect temperatures, replace defective gage. If gage indicates correct temperatures, replace defective sending unit (para 2-61). Replace sending unit which was switched to transmission oil temperature sending unit.

6. BATTERY GENERATOR GAGE INDICATES INCORRECT CONDITION OF BATTERIES (CIRCUIT 27).
    Assure batteries, contacts, connectors, and harnesses are in operative conditions.
        Replace defective gage (para 2-74***a***(5)).

7. ENGINE OIL PRESSURE GAGE INDICATES INCORRECT PRESSURE (CIRCUIT 36).
    Replace engine oil pressure sending unit (para 2-61).
        If still defective, replace gage (para 2-74***a***(2)).

8. FUEL LEVEL INDICATOR GAGE INDICATES INCORRECT LEVELS (CIRCUIT 30).
    Replace fuel level sending unit. (para 2-62).
        If still defective, replace gage (para 2-74***a***(4)).

Table 2-17 · Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WARNING LIGHTS AND BUZZER SYSTEM

DESCRIPTION: The warning buzzer is energized whenever the tractor air pressure is below 60 ± 6 psi or the vehicle engine speed is over 2650 rpm.

When the air pressure is low, the tractor low pressure switch closes, completing circuit 85. This circuit gets power from circuit breaker 2 via circuit 685A. Circuit 85 then energizes the warning buzzer through closed contacts in the warning buzzer relay. This circuit also illuminates the tractor air pressure warning light on the panel (fig. 2-28).

When the engine is overspeeding, the tachograph has a switch which closes and illuminates a warning light. The buzzer relay coil is energized by circuit 685, which is completed by the tachograph rpm switch. This coil closes circuit 685A, which energizes the warning buzzer. The warning buzzer may be interrupted momentarily (during starts or maintenance) by depressing the warning buzzer shut-off switch. This switch opens circuit 85, which is the power circuitry to the buzzer.

The trailer air pressure warning light circuit (circuit 53B) is completed when pressure in the trailer drops below 60 ± 6 psi.

One side of the TRANS. PRESS warning light is connected to the starter switch. The light illumnates when the circuit is completed to ground by the closing of the trans low-oil press switch on the transmission. The switch is normally closed, completing circuit 655, and opens when transmission pressure is above 160 ± 10 psi.

The engine and trans warning light is also connected to the starter switch. The circuit is completed to ground through any of three circuits: circuit 34, engine low-oil pressure; circuit 33A, engine hi-water temp.; or circuit 327, transmission hi-oil temp. The engine low-oil pressure switch is normally closed and opens when oil pressure is above 4-8 psi. The engine hi-water temp switch is normally open and closes at temperatures above 205° ± 5°F. The trans hi-oil temp switch is also normally open and closes at temperatures above 265°F ± 5°F.

The auxiliary steering warning lamp is connected to the starter switch. The circuit is completed to ground via circuit 650 when hydraulic pressure for steering is below 400 psi.

The trans press and engine and trans warning lights should both be on when the starter switch is ON and the engine not running, since two of the warning switches are normally closed. After the engine is started, and running 10-15 seconds, both lights should go off, indicating there are safe operating oil pressures in the engine and transmission.

The tractor air pressure and the trailer air pressure warning lights may also be on when the starter switch is turned ON. The hydraulic and air pumps are driven off the engine. Once the engine is started and running for 10-15 seconds, the pressure should build up in those systems and the warning lights should go off.

Since the auxiliary steering pump is connected to the front axle, the auxiliary steering warning light will be on at all times except when the vehicle is moving above 3-5 mph. Sufficient pressure should then build up to open the switch and de-energize the warning lamp.

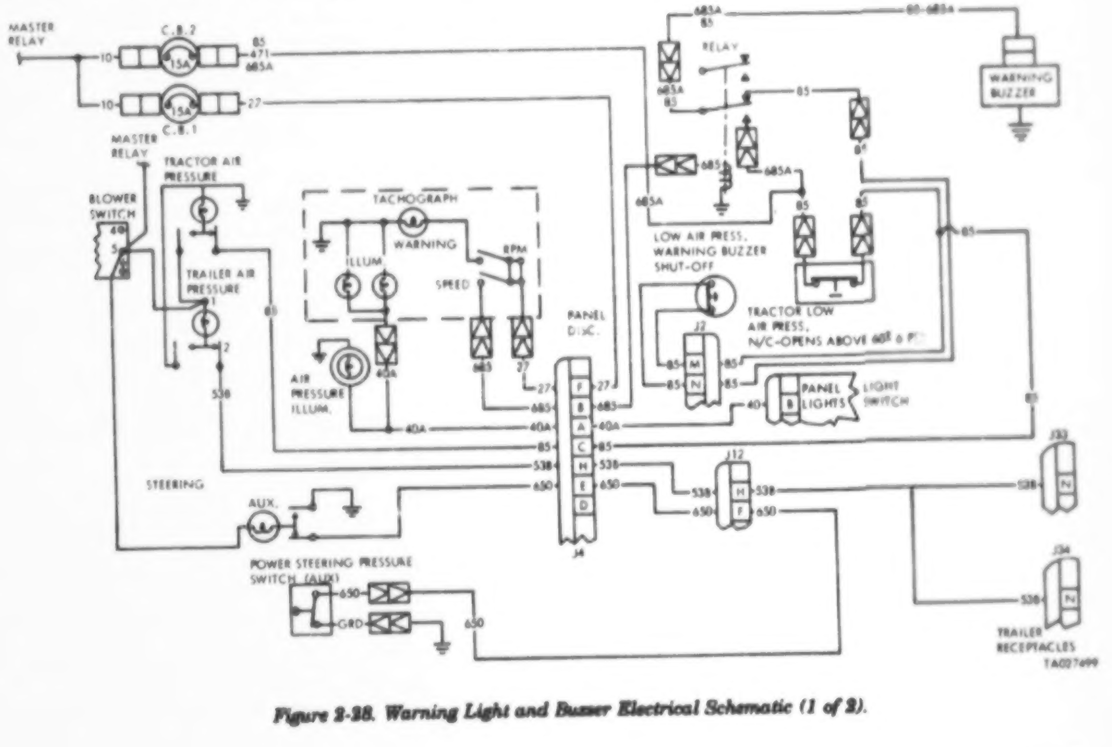

MASTER RELAY
C.B. 2
15A
10
85
471
685A
C.B. 1
27
MASTER RELAY
TRACTOR AIR PRESSURE
BLOWER SWITCH
TRAILER AIR PRESSURE
85
53B
TACHOGRAPH
WARNING
ILLUM
RPM
SPEED
AIR PRESSURE ILLUM.
40A
685
27
PANEL DISC.
F
B
A
C
H
E
D
J4
STEERING
AUX.
POWER STEERING PRESSURE SWITCH (AUX)
650
GRD
RELAY
685A
85
WARNING BUZZER
LOW AIR PRESS. WARNING BUZZER SHUT-OFF
TRACTOR LOW AIR PRESS. N/C-OPENS ABOVE 60 ± 6 PSI
J2
M
N
PANEL LIGHTS
LIGHT SWITCH
J12
J33
J34
TRAILER RECEPTACLES
TA027699

Figure 2-28. Warning Light and Buzzer Electrical Schematic (1 of 2).

Table 2-17 - Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

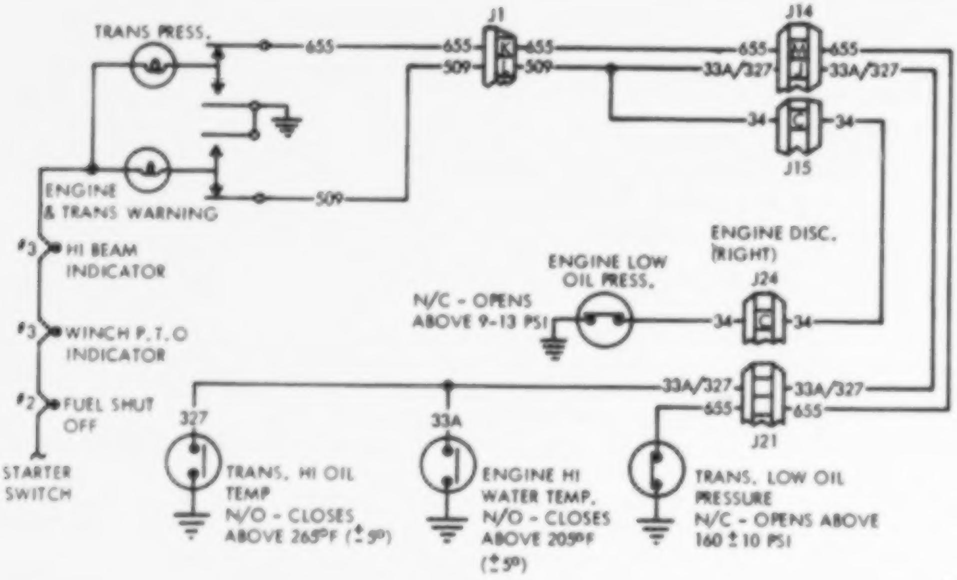


Figure 2-28. Warning Light and Buzzer Electrical Schematic (2 of 2).

1. TRAILER AIR PRESSURE WARNING LAMP INOPERATIVE WHEN TRAILER AIR PRESSURE IS BELOW 55 PSI (CIRCUIT 53B).

Step 1. Turn starter switch to RUN position. Assure bulb is good (push in press-to-test lens).

If light does not operate, replace bulb. If bulb is still inoperative, proceed to malfunction 8, step 1.

Step 2. Deplete system air to 55 psi or less. Trailer air pressure warning light should be on. If it is, malfunction has been corrected. If not, disconnect J33 at gooseneck. Connect a jumper wire from ground to J33N on connector going to tractor. If light is on now, trouble is in trailer circuit; see TM 9-2330-294-14. If light is not on, disconnect J12 from cab. Connect a jumper wire from ground to J12H on connector going to panel. If light is on now, harness between J12 and J33 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 3. If light is not on, disconnect J4 from panel. Set multimeter to check continuity (RX1 scale). Connect red lead to harness connector J4H and black lead to J12H (connector on harness going to panel). If continuity exists (full needle deflection to right), proceed to step 4. If continuity does not exist (very little or no deflection), harness between J4 and J12 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Set multimeter to check continuity (RX1 scale). Connect black lead to terminal # 2 of warning light assembly and red lead to J4H of panel connector. If continuity exists (full deflection of the needle to right), replace defective lamp assembly (para 2-75*b*). If no continuity exists, harness between warning lamp and J4 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

2. TRACTOR AIR PRESSURE WARNING LIGHT INOPERATIVE WHEN PRESSURE IS BELOW 55 PSI (WARNING BUZZER DOES OPERATE) (CIRCUIT 85).

Step 1. Turn starter switch to RUN position. Assure bulb is good (push in press-to-test lens).

If light does not operate, proceed to malfunction 8, step 2. If light operates, proceed to step 2 below.

Step 2. Deplete air pressure below 55 psi (disconnect wire 85-685 from warning buzzer to keep it from operating). If warning light is on, malfunction has been corrected. If not, disconnect J4 from panel. Set multimeter for 50 vdc and check for voltage from harness connector. Connect red lead to J4C and black lead to ground. If 24 volts exist, reconnect J4 and proceed to step 3. If 24 volts does not exist, harness between J4 and tractor low air pressure switch is defective; replace harness (para 2-65).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Set the multimeter for 50 vdc. Connect red lead to terminal # 2 of warning light assembly and black lead to ground. If 24 volts exist, replace warning light assembly. If 24 volts does not exist, harness between lamp assembly and J4 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Table 2-17 - Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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3. WARNING BUZZER DOES NOT OPERATE WHEN TRACTOR AIR PRESSURE IS BELOW 55 PSI (WARNING LIGHT DOES OPERATE) (CIRCUITS 85, 685A, 85-685)

Step 1. Turn starter switch to RUN and deplete air pressure below 55 psi. Disconnect wire 85-685A from warning buzzer. Set multimeter for 50 vdc. Connect red lead to wire 85-685A and black lead to ground.

If 24 volts is present, replace defective warning buzzer (para 2-84). If 24 volts is not present, proceed to step 2.

Step 2. Disconnect wire 85 from warning buzzer relay. Set multimeter for 50 vdc, connect red lead to wire 85 and black lead to ground.

If 24 volts is present, reconnect and proceed to step 3. If 24 volts is not present, proceed to step 3A.

Step 3. Disconnect wire 685A/85 from relay. Connect red lead to relay connector 685A/85 and black lead to ground. If 24 volts does not exist, replace defective warning buzzer relay (para 2-78).

If 24 volts exist, harness between relay and warning buzzer is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 3A. Disconnect J2 from panel. Set multimeter to test voltage for 50 vdc. Connect red lead to harness connector J2M and black lead to ground. If 24 volts exist, proceed with test. If 24 volts does not exist, harness between J2 and trailer low air pressure warning switch is defective. Set multimeter for continuity on RX1 scale. Connect one lead to panel connector for J2M and other lead to panel connector J2N. If continuity exists, harness between J2 and buzzer relay is defective. If continuity does not exist, remove leads from connector J2. Connect one lead to terminal #1, and other lead to terminal #2 on rear of warning buzzer shutoff switch.

If continuity does not exist, replace warning buzzer shutoff switch. If continuity does exist, wiring between switch and connector J2 is defective, replace (para 2-79). Inspect connector and connections for bent, loose or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

4. NEITHER THE WARNING LIGHT NOR THE BUZZER OPERATES WHEN AIR PRESSURE IS BELOW 55 PSI (CIRCUITS 10, 685A, 85).

Step 1. Deplete air pressure below 55 psi. Turn starter switch to RUN position. Disconnect wire 10 from circuit breaker 2 and set multimeter for 50 vdc. Connect black lead to ground and red lead to wire 10. If 24 volts does not exist, harness between C.B. 2 and master relay is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 1A. If 24 volts is present, reconnect wire 10 and disconnect the other wire on circuit breaker (wire 85/471/685A). Connect black lead to ground and red lead to circuit breaker connector. If 24 volts exist, reconnect and proceed to step 2.

If 24 volts does not exist, replace defective circuit breaker #2.

Step 2. Disconnect two wires from tractor low-pressure switch. Set multimeter for 50 vdc. Connect black lead to ground and red lead to one of connectors (connect red lead to harness connectors going to warning buzzer relay). If 24 volts is not present, connect red lead to other connectors pulled off from switch. If 24 volts is not present on either of connectors, harness between C.B. 2 and tractor low-air pressure switch is defective (para 2-79). If 24 volts is present on a connector, reconnect it to tractor low-air pressure switch. Connect red lead of multimeter to free connector on tractor low pressure switch, and black lead to ground.

If 24 volts is not present, replace defective tractor low pressure switch (para 2-74). If 24 volts is present, harness between low pressure switch J2 and J4 is defective (para 2-79). Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunctions are evident or cannot be determined, notify supporting maintenance to replace harness.

5. WARNING BUZZER WILL NOT OPERATE WHEN ENGINE SPEED IS OVER 2650 RPM (CIRCUITS 27, 685, 685A).

Step 1. Deplete air pressure below 55 psi. Turn starter switch in ON position. If warning buzzer does not sound, observe tractor air pressure warning light. If the warning light is on, proceed to malfunction 3, step 1. If the light is not on, proceed to malfunction 4, step 1. If warning buzzer does not sound, remove wire 85-685A from buzzer. (Install wire when troubleshooting is finished.) Disconnect wire 685A from warning buzzer relay. Set multimeter for 50 vdc and connect red lead to the connector disconnected from relay, and black lead to ground. If 24 volts are present, reconnect and proceed to step 2. If 24 volts are not present, harness between relay C.B. 2 and tractor low pressure switch is defective (para 2-79).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 2. Disconnect wires 685 and 27 from tachograph. Connect a jumper wire across two connectors which are not from tachograph. (Leave jumper connected until trouble is found.) Disconnect wire 685A/85 from buzzer relay. Connect red lead of multimeter to relay connector and black lead to ground.

If 24 volts is present, replace defective tachograph (para 2-76*d*). If 24 volts is not present, disconnect wire 685 from buzzer relay. Connect red lead to connector just removed from relay (685) and black lead to ground. If 24 volts is present, replace defective buzzer relay (para 2-78). If 24 volts are not present, proceed to step 3 below.

Step 3. Disconnect J4 from the panel, check harness connector for 24 volts. Connect red lead of multimeter to J4F and black lead to ground. If 24 volts are present, proceed with step 4. If 24 volts ae not present, harness between J4 and circuit breaker 1 is defective (para 2-79).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Set multimeter to check continuity (RX1 scale). Connect one lead of meter to panel connector J4F and other lead to J4B. (JUMPED WIRE IN STEP 2 MUST STILL BE CONNECTED.) If continuity exists (full deflection of needle to right), harness between J4 and buzzer relay is defective. If continuity does not exist (no deflection), harness between J4 and the tachograph is defective (para 2-79).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Table 2-17 - Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. TRAILER AIR PRESSURE, OR STEERING (AUXILIARY) WARNING LIGHT WILL NOT ILLUMINATE WHEN THE PRESS-TO-TEST LENS IS PRESSED IN (STARTER SWITCH IN RUN POSITION).

Assure defroster blower motors operate. If not, see troubleshooting procedures for Defroster Blower System, table 2-19. If operative, proceed with test. Turn off starter switch. Set multimeter for a continuity check on RX1 scale. Check for continuity from terminal #3 (on back side of malfunctioning lamp socket) to ground. Connect red lead to terminal #3 of malfunctioning socket, and black lead to ground. Full needle deflection to right, indicating continuity, should occur on meter. If not, replace wire from terminal #3 to ground. If continuity does exist, disconnect red lead from terminal #3 and connect it to terminal #1. Set meter for 50 vdc to measure voltage. Place master switch in ON position; 24 volts should exist from terminal #1 to ground.

If 24 volts exist, replace defective lamp socket assembly (para 2-75). If 24 volts does not exist, replace wire from terminal #5 of defroster blower switch to terminal #1 of malfunctioning lamp (para 2-79).

7. TRACTOR AIR PRESSURE WARNING LIGHT WILL NOT ILLUMINATE WHEN PRESS-TO-TEST LENS IS PRESSED IN.

Assure press-to-test lamp of trailer air pressure lamp is operative. If not, see malfunction 6 above. Assure defroster blower motors operate. If not, see troubleshooting procedures for Defroster Blower System, table 2-19. Turn master switch in OFF position. Set multimeter for a continuity check on RX1 scale. Check for continuity from terminal #1 (on back side of socket) to ground. Connect red lead to terminal #1 of tractor air pressure socket and black lead to ground. Full needle deflection to right, indicating continuity, should occur on meter. If not, replace wire from terminal #1 to ground (para 2-79). If continuity does exist, disconnect red lead from terminal #1 and connect it to terminal #3. Set meter for 50 vdc to measure voltage. Place master switch in ON position.

If 24 volts exist, replace defective lamp socket. If 24 volts does not exist, replace wire from terminal #3 of socket to terminal #1 of trailer air pressure socket (para 2-79).

8. TRANSMISSION PRESSURE WARNING LIGHT DOES NOT ILLUMINATE WHEN STARTER SWITCH IS ON AND ENGINE NOT RUNNING OR WHEN TRANSMISSION OIL PRESSURE IS BELOW 150 PSI (CIRCUIT 655).

Step 1. Turn starter switch to RUN. Press in lens to check if bulb will light. If not, replace bulb. If press-to-test circuit is still inoperative, proceed to malfunction 11. If the bulb does light when pressed in, continue with test. Disconnect the connector on the transmission low-oil pressure switch (on transmission). Set the multimeter for continuity test on RX1 scale. Connect red lead to switch terminal and black lead to ground. If continuity exists (full deflection of needle to right), reconnect wire to switch and proceed to step 2.

If continuity does not exist, replace defective transmission low-oil pressure switch (para 2-61).

Step 2. Turn starter switch OFF. Disconnect J21 from right engine disconnect. Check for continuity from panel connector to ground. Connect red lead of multimeter to J21M, and black lead to ground. If continuity does not exist, harness between J21 and the transmission low-oil pressure switch is defective. If continuity does exist, reconnect J21 and disconnect J14 at cab disconnect. Check for continuity from J14 to ground. Connect red lead of multimeter to J14M (connector coming from engine) and black lead to ground. If continuity does not exist, harness between J14 and J21 is defective. If continuity does exist, reconnect J14 and disconnect J1 on the panel. Check for continuity from J1 to ground. Connect red lead of multimeter to J1K (harness connector) and black lead to ground. If continuity does not exist, harness between J1 and J14 is defective. If continuity does exist, reconnect J1. Connect red lead of multimeter to terminal #1 of transmission pressure warning light and black lead to ground.

If continuity exists, replace defective lamp socket assembly (para 2-74). If continuity does not exist, wire between terminal #1 and connector J1 is defective (para 2-79). Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

9. ENGINE AND TRANSMISSION WARNING LIGHT DOES NOT ILLUMINATE WHEN STARTER SWITCH IS IN RUN POSITION AND ENGINE NOT RUNNING (CIRCUITS 509, 34).

Step 1. Turn starter switch to RUN. Press in lens to check if bulb will light. If not, replace bulb and try again (para 2-74). If lamp will not light, proceed to malfunction 11. If press-to-test circuit is operative, proceed with test. Disconnect connector on engine low-oil pressure switch (on engine). Set multimeter on RX1 scale to test for continuity. Connect red lead to terminal of switch and black lead to ground. If continuity exists (full deflection of needle to right), proceed to step 2.

If continuity does not exist, replace defective engine low-oil pressure switch (para 2-61).

Step 2. Turn starter switch OFF. Disconnect J24 from right engine disconnect. Check for continuity from J24 to ground. Connect red lead of multimeter to J24C (connector on cowl) and black lead to ground. If continuity does not exist, harness between J24 and engine low-oil pressure switch is defective. If continuity does exist, reconnect J24 and disconnect J15 at the cab disconnect. Connect red lead to J15C (connector coming from engine) and black lead to ground. If continuity does not exist, harness between J15 and J24 is defective. If continuity exists, reconnect J15 and disconnect J1 at panel. Connect red lead of multimeter to J1L (harness connector) and black lead to ground. If continuity does not exist, harness between J1 and J15 is defective. If continuity does exist, reconnect J1. Connect red lead of multimeter to terminal #1 of engine and transmission warning light (rear of socket), and black lead to ground.

If continuity exists, replace defective lamp socket assembly (para 2-74). If continuity does not exist, harness between terminal #1 and connector J1 is defective (para 2-79). Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

10. ENGINE AND TRANSMISSION WARNING LIGHT DOES NOT ILLUMINATE WHEN ENGINE COOLANT TEMPERATURE IS ABOUT 210°F OR WHEN TRANSMISSION TEMPERATURE IS ABOVE 270°F (CIRCUITS 327, 33A, 509).

Step 1. Assure engine and transmission warning light illuminates when master switch is ON and engine is not running. If not, proceed to malfunction 9, step 1. Turn starter switch to ON position. Disconnect engine low-oil pressure switch connector so warning light is not on. Disconnect connector from malfunctioning switch located on engine or transmission. (Transmission hi-oil temperature switch if transmission overheats, or engine water temperature switch if engine overheats.) Connect a jumper wire from ground to connector (harness end) which was taken off the malfunctioning switch. If warning light is on now, replace defective switch (located on engine or transmission) (para 2-61). If warning light is not on, disconnect J21 from right engine disconnect. Connect a jumper from J21J (harness connector) to ground. If warning light is on now, harness between J21 and switch on engine or trans-

Table 2-17 - Troubleshooting - Continued

MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

mission is defective. If light is not on, reconnect J21 and disconnect J14 from the cab disconnect. Connect a jumper from J14J (connector going to panel) to ground. If warning light is on now, harness between J14 and J21 is defective. If light is not on, harness between J14 and J15 is defective.

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

11. TRANSMISSION PRESSURE OR ENGINE AND TRANSMISSION WARNING LIGHTS DO NOT ILLUMINATE WHEN LENS IS PRESSED IN.

Step 1. Turn starter switch to RUN position. Assure hi-beam indicator (headlights) press-to-test bulb operates. If not, see troubleshooting procedures for Directional Signal System, table 2-27. Turn master switch OFF. Set multimeter to test continuity on RX1 scale. Connect red lead to terminal # 3 of malfunction lamp socket assembly, and black lead to ground. If continuity does not exist, replace wire from terminal # 3 to ground. If continuity exists, remove meter leads and set multimeter for 50 vdc. Connect red lead to terminal # 2 and black lead to ground. Turn starter switch to ON position.

If 24 volts exist, replace defective lamp socket assembly (para 2-74). If testing engine transmission warning light, and 24 volts does not exist, replace wire from terminal # 2 of engine and transmission warning lamp to terminal # 3 of hi-beam indicator lamps (para 2-79).

Step 2. If testing transmission pressure warning light and 24 volts does not exist, place red lead to meter on terminal 2 of engine and transmission warning lamp (Black lead still to ground).

If 24 volts exist here, replace wire from this terminal # 2 of transmission pressure warning light (para 2-79). If 24 volts does not exist, replace wire from this terminal to terminal # 3 of hi-beam indicator lamp (para 2-79).

12. TRANSMISSION PRESSURE WARNING LIGHT WILL NOT GO OUT AFTER ENGINE IS STARTED (CIRCUIT 655).

Step 1. Turn starter switch to RUN position. Disconnect connector from transmission low-oil pressure switch. If light goes out, replace pressure switch (para 2-63), reconnect connector and start engine. The light should go out within 10-15 seconds. If not, notify supporting maintenance. If light does not go out when connector is removed, disconnect J21 from right engine disconnect. If light goes out, harness between J21 and pressure switch is defective. If light is still on, reconnect J21 and disconnect J14 from cab disconnect. If light goes off, harness between J14 and J21 is defective. If light stays on, reconnect J14 and disconnect J1 at panel. If light stays on, proceed to malfunction 14. If light goes out, harness between J1 and J14 is defective.

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 2. Turn starter switch OFF. Remove wire from terminal # 1 of the malfunctioning lamp assembly. Turn starter switch to START. If lamp is still on, replace defective lamp assembly (para 2-74). If lamp is not on, replace harness from terminal # 1 to connector J1 (para 2-79).

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

13. ENGINE AND TRANSMISSION WARNING LIGHT DOES NOT GO OUT AFTER ENGINE IS STARTED.

Step 1. Start engine and check pressure and temperature gages. Engine oil pressure should be above 10-15 psi, transmission temperature gage below 265°F, and engine coolant temperature below 205°F. If any gage is not in specified range, notify supporting maintenance. If all gages are satisfactory, keep engine running and remove connector from engine low-oil pressure switch. If light goes out, replace engine low-oil pressure switch (para 2-60). If not, disconnect connector from engine hi-water temperature switch. If light goes out, replace temperature switch (para 2-61). If not, disconnect transmission hi-oil temperature switch connector. If light goes off, replace transmission switch (para 2-61). If not, reconnect all connects and disconnect J24 from right engine disconnect. If light goes off, harness between J24 and engine low-oil pressure is defective. If not, reconnect J24 and disconnect J21. If light goes off, harness between J21 and temperature switches is defective. If not, reconnect J24 and disconnect J15 at cab disconnect. If the light goes off, harness between J15 and J24 is defective. If not, reconnect J15 and disconnect J14. If light goes off, harness between J14 and J21 is defective. If not, reconnect J14 and disconnect J1 from panel. If lights go off, harness between J1 and J14, J15 is defective. If not, proceed to malfunction 12, step 2.

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 2. Remove wire from terminal # 2 of malfunctioning lamp socket (on rear of socket assembly). Set up multimeter on RX1 scale for a continuity test. Connect red lead to terminal # 2 of socket assembly and black lead to ground. If continuity exists (full deflection of needle to right) replace defective lamp assembly (para 2-74). If continuity does not exist, harness between terminal # 2 and connector J4 is defective.

Inspect connector for bent or dirty contacts. Make necessary repairs (para 2-79).

14. AUXILIARY STEERING WARNING LIGHT STAYS ON AFTER VEHICLE HAS OBTAINED A SPEED ABOVE 5 MPH OR LIGHT COMES ON DURING OPERATION OF VEHICLE AND STAYS ON (CIRCUIT 650A).

Step 1. Place starter switch in ON position. Remove ground connector from auxiliary power steering pressure switch. If light goes out, see Power Steering troubleshooting table 2-8 (check hydraulic fluid pressure when vehicle is above 5 mph); if light stays on, remove other connector (wire 650) from switch. If light goes off now, replace defective auxiliary power steering pressure switch (para 2-142*c*). If light is still on, disconnect J12 from cab disconnect. If light goes out, harness between J12 and switch is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 2. If light stays on, reconnect J12 and turn starter switch in OFF position. Disconnect J4 from panel. Set up multimeter to check continuity on RX1 scale. Connect red lead to J4E (panel connector) and black lead to ground. If continuity exists (full deflection

Table 2-17 · Troubleshooting · Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

of needle to right), proceed to malfunction 13, step 2. If continuity does not exist, harness between J4 and J12 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

15. AUXILIARY STEERING WARNING LAMP WILL NOT ILLUMINATE WHEN THE STARTER SWITCH IS ON AND THE ENGINE NOT RUNNING.

Step 1. Turn starter switch to ON position. Press in press-to-test lens on malfunction warning lamp. If light does not illuminate, replace bulb (para 2-75) and test again. If light will not illuminate when pressed in, proceed to malfunction 6. If light does illuminate, when pressed in, disconnect "grd." wire from malfunctioning power steering pressure switch. Connect a jumper wire from ground connector (connector on switch) to vehicle ground. If light comes on, replace wire from ground connector to ground. If light does not come on, reconnect and remove other wire from switch. Connect a jumper from harness connector to ground. If light comes on now, replace defective power steering pressure switch (para 2-142). If light does not come on, proceed to step 2.

Step 2. Disconnect J12 and connect a jumper wire from ground to J12F of connector on harness going to front panel. If light comes on, harness between J12 and power steering pressure switch is defective. If light does not come on, reconnect connectors and connect a jumper wire from terminal # 2 of malfunction lamp socket assembly to ground. If light does not come on, replace defective lamp assembly (para 2-75). If light comes on, proceed to step 3.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Turn starter switch in OFF position and disconnect J4 from panel. Set up the multimeter for a continuity test on RX1 scale. Connect red lead to terminal # 2 of malfunctioning lamp and black lead to panel connector J4E. If continuity exists (full deflection of needle to right) harness between J4 and J12 is defective.

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Table 2-18 · Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WINDSHIELD WIPER SYSTEM

DESCRIPTION: The single speed windshield wiper motors are connected in parallel and are operated by a two position switch (fig. 2-29). Voltage is applied to the control switch by circuit No. 71 from circuit breaker No. 9 which is energized when the master relay is closed by turning on the master switch. The single speed motors have two terminals. Only Terminal A on the motors is energized by circuit 71A from the control switch. The second terminal on the motors are connected through the harness to a common ground.

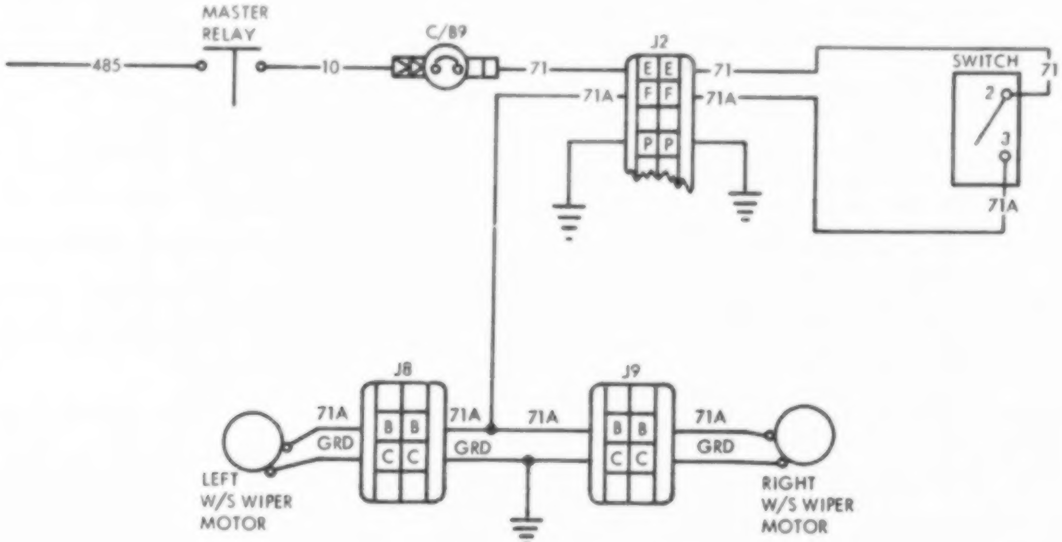

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Figure 2-29. Windshield wiper system.

Table 2-18 - Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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1. BOTH WINDSHIELD WIPERS INOPERATIVE (CIRCUITS 10, 71, 71A)

Step 1. Place master switch in ON position. Disconnect connector J2 and check for 24 volts from contact E (connector on panel) to ground. Set multimeter for 50 vdc, red lead to J2E, black lead to ground.

If 24 volts is present, reconnect J2, proceed to step 3. If not, proceed to step 2.

Step 2. Disconnect wire No. 71 from C.B. 9. Set multimeter for 50 vdc, black lead to ground, red lead to C.B. 9 terminal. If 24 volts is not present, see troubleshooting starter System, table 2-14.

If 24 volts is present, harness between C.B. 9 and J2 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 3. With a multimeter set for 50 vdc, place black lead to vehicle ground, red lead to terminal 2 of windshield wiper switch. If 24 volts are not present, harness between switch and J2 is defective. If 24 volts are present, place switch in ON position and check terminal 3 of wiper switch. Inspect connectors for bent or dirty contacts.

If 24 volts are not indicated at terminal 3, replace wiper switch. Make necessary wiring repairs (para 2-79).

2. ONE W/S WIPER MOTOR MALFUNCTIONING, OTHER ONE OPERATIVE (CIRCUITS 71, 71A)

Turn starter switch to RUN. Disconnect J8 (if left motor is inoperative) or J9 (right motor inoperative) from panel. Turn W/S wiper switch ON. With a multimeter set for 50 vdc, check contacts of connector on panel for following voltages (Chart 6). Place black lead to ground, red lead to contact specified.

Contact	*Voltage*
B	24V
C	0V

Chart 6

If all voltages are present, replace defective W/S wiper motor (para 2-88). If all voltages are not present, harness between connector J8 or J9 and connector J2 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-19. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

DEFROSTER BLOWER MOTOR SYSTEM

DESCRIPTION: There are two independent defroster blower motors for either side of the windshield. The cab air is used for defrosting the windshield. Four adjustable vents, two for each side of the windshield, are provided to regulate air flow. Circuit 411 is used to energize the motors (fig. 2-30). Power comes from the meter relay through circuit breaker #4 and to the three position switch; OFF, LEFT ON (circuit 411A) to defrost the driver's side of the windshield, and LEFT and RIGHT ON (circuit 411A and 411B) to defrost the whole windshield.

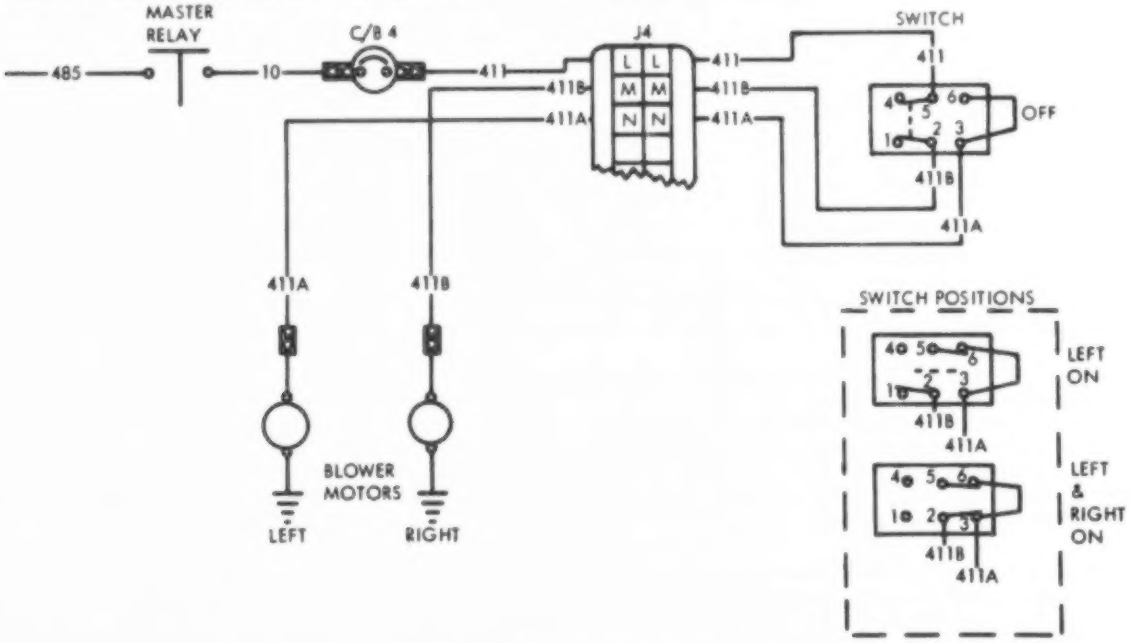

Figure 2-30. Defroster blower motors electrical schematic.

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Table 2-19. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. BOTH DEFROSTER BLOWER MOTORS ARE INOPERATIVE (CIRCUITS 10, 411).

Step 1. Turn starter switch to RUN position. Disconnect wire 411 from circuit breaker 4. With a multimeter set for 50 vdc, check for 24 volts at circuit breaker terminal. Place red lead on terminal and black lead to ground.

If 24 volts exist, reconnect and proceed to step 3. If 24 volts does not exist, proceed to step 2.

Step 2. Disconnect wire 10 from C.B. 4. Check for 24 volts from wire #10 to ground. Place red lead to wire #10, black to ground.

If 24 volts exist, replace defective circuit breaker #4. If 24 volts does not exist, harness between C.B. 4 and master relay is defective. Inspect for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 3. Disconnect J4 from panel. With a multimeter set for 50 vdc, check at harness connector J4L for 24 volts. Connect red lead on J4L, black lead to ground.

If 24 volts is present, reconnect and proceed to step 4. If 24 volts is not present, harness between J4 and C.B. 4 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. In any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 4. Connect red lead of multimeter to terminal 5 of defroster motor switch, and black lead to ground.

If 24 volts are present, replace defective defroster motor switch. If 24 volts are not present, harness between switch and J4 is defective. Inspect connector for bent or dirty contacts. Make necessary repairs (para 2-75).

2. RIGHT DEFROSTER MOTOR IN INOPERATIVE.

Step 1. Turn starter switch to RUN position. Turn defroster switch in RIGHT and LEFT position. Place red lead of multimeter on terminal #2 of defroster switch, and black lead to ground.

If 24 volts is present, proceed to step 2. If not, replace defective defroster blower motor switch (para 2-75).

Step 2. Disconnect wire from malfunctioning motor (wire 411B if right, wire 411A if left). With a multimeter set for 50 vdc, connect red lead to wire and black lead to ground.

If 24 volts exist, replace defective blower motor (para 2-181). If 24 volts does not exist, proceed to step 3.

Step 3. Disconnect J4 from panel. Check J4M (J4N if left blower motor inoperative) for 24 volts. Connect red lead to panel connector contact, and black lead to ground.

If 24 volts exist, harness between J4 and defroster motor is defective. If 24 volts does not exist, harness between J4 and switch is not defective. Inspect connectors for bent or dirty contacts. Make necessary repairs (para 2-79).

3. LEFT BLOWER MOTOR DOES NOT OPERATE.

Turn starter switch in RUN position. Place defroster blower switch in LEFT position and proceed with malfunction 2, step 2.

Table 2-20. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

PERSONNEL HEATER SYSTEM

DESCRIPTION: The personnel heater produces heat by burning a mixture of fuel and air in a sealed, all-welded stainless steel heat exchanger. Ventilating air, and air for combustion, are supplied by two separate blowers whch are mounted on the shaft of a single 24-volt electric motor. This provides a compact and simple design, but still maintains the proper pressure relationships so that efficient combustion can be maintained for high and low heat operation while having an adequate temperature rise in the ventilating air system (fig. 2-31). Flow of fuel to the heat exchanger is regulated by a fuel control valve on the top of the heater housing. To insure proper control of fuel flow under all conditions, this valve is designed to regulate pressure of the incoming fuel, maintain fuel temperature within a range suitable for metering, and to meter the fuel for high and low heat operation. Pressure is regulated by an adjustable diaphragm and needle valve pressure regulator. Fuel temperature is held within limits by use of a heating element in the base of the fuel control valve, plus a thermostat to regulate flow of current to the heating element. Fuel flow is controlled by an on-off solenoid valve, an orifice plate with calibrated openings, and a restriction solenoid valve to control flow through the orifice plate (fig. 2-32).

Fuel enters the burner assembly and is ignited by an electric pancake type element similar to a cigarette lighter. The igniter is located in a small "boot-shaped" housing between the combustion air blower and the burner. The igniter rests in what might be compared to the leg of the "boot", and the open toe is welded into the burner plate. A small strand of wicking material leads fuel from the main fuel vaporizer, back to an area just under the igniter. When a flame is established in this ignition pocket, a small jet of flame plays out of the "toe" of the boot onto the main fuel vaporizer and ignites the main burner.

To preserve the life of the igniter and the heating element of the fuel preheaters, a flame detector switch is incorporated into the design of the heater. The flame detector switch consists of a microswitch mechanism mounted on a bracket which includes a stainless steel tube. A quartz or ceramic rod is enclosed in the tube in such a manner that its upper end presses against a linkage to actuate the microswitch and the lower end presses against the bottom of the tube. The purpose of this assembly is to shut off the igniter and fuel preheaters as soon as flame has been established within the heater. When the switch transfers, it also removes a resistor from the blower circuit, permitting the blower to operate at full speed.

In addition to the controls described above, the heater is also equipped with an overheat switch in the fuel control valve electric system. This switch is a bimetal element which will brake the electric circuit and shut off fuel flow in the event that the temperature of the ventilating air stream exceeds a safe maximum.

1. HEATER FAILS TO START WHEN CONTROL SWITCH IS TURNED ON (CIRCUITS 400, 402, 404).

Step 1. Hold heater control switch in START position. Check heater fuel pump for operation (audible clicking).

If pump is operation, proceed to step 7. If not, proceed to step 2.

Step 2. Disconnect wire No. 400 from heater control box. Check wire for 24 volts. Set multimeter for 50 vdc, red lead to wire No. 400, black lead to ground.

Table 2-20. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

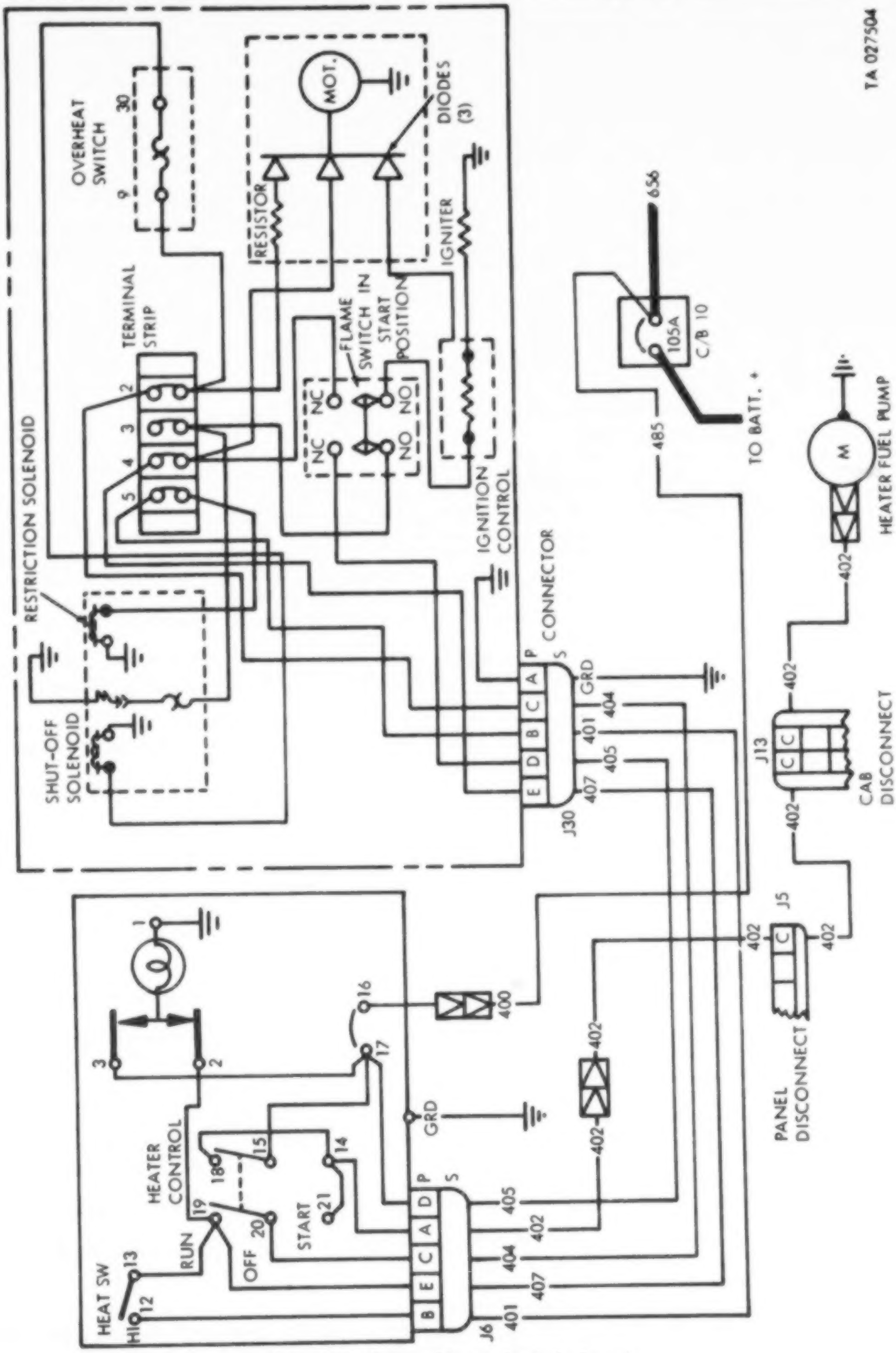
TA 027504
OVERHEAT SWITCH
9
30
MOT.
DIODES (3)
RESISTOR
IGNITER
TERMINAL STRIP
2
3
4
5
FLAME SWITCH IN START POSITION
NC
NO
IGNITION CONTROL
RESTRICTION SOLENOID
SHUT-OFF SOLENOID
CONNECTOR
P
S
A
B
C
D
E
GRD
404
401
405
407
J30
656
105A
C/B 10
485
TO BATT. +
HEATER FUEL PUMP
M
402
J13
C
CAB DISCONNECT (LEFT)
J5
PANEL DISCONNECT
400
1
3
2
16
17
GRD
HEATER CONTROL
18
15
14
19
20
21
RUN
OFF
START
HEAT SW
HI
12
13
J6

Figure 2-32. Personnel heater electrical schematic.

Table 2-20. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

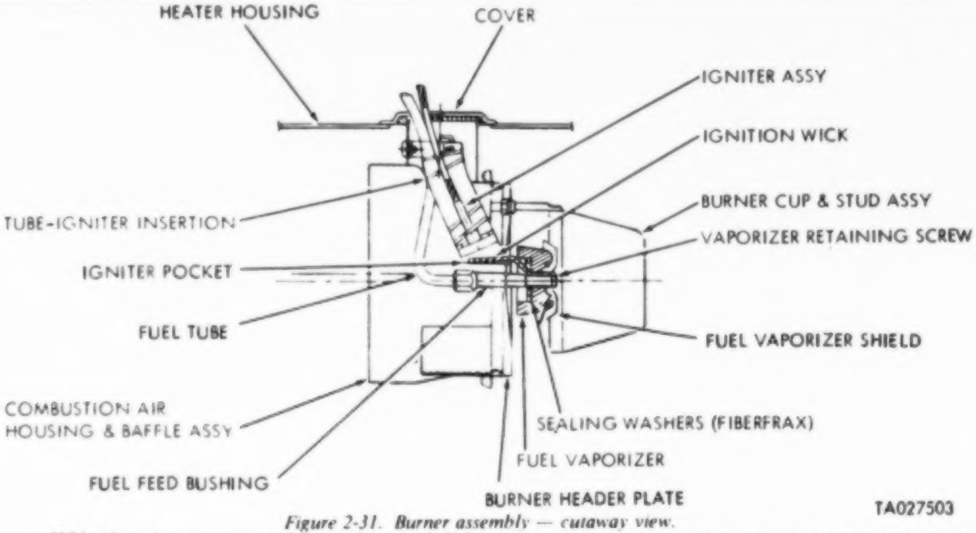

Figure 2-31. Burner assembly — cutaway view.

If 24 volts exist, reconnect and proceed to step 3. If 24 volts is not present, harness from control box to batteries is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunctions are evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Disconnect wire 402 from heater fuel pump. Check for 24 volts from wire 402 to vehicle ground. Set multimeter for 50 vdc, red lead to wire 402, black lead to ground.

If 24 volts exist, replace defective heater fuel pump (para 2-180). If 24 volts does not exist, proceed to step 4.

Step 4. Disconnect J6 from control box. Check contact A on control box for 24 volts. Multimeter set for 50 vdc, red lead to A, black lead to vehicle ground.

If 24 volts is not present, replace or repair defective heater control box (para 2-75*f*). If 24 volts is present, proceed to step 5.

Step 5. Reconnect J6 to control box. Disconnect J5 from panel and check J5C (connector on panel) for 24 volts. Set multimeter for 50 vdc, red lead to J5C, black lead to vehicle ground.

If 24 volts is present, reconnect and proceed to step 6. If 24 volts is not present, harness between J5 and control box is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 6. Disconnect J13 from cab disconnect. Check for 24 volts from J13C to ground (from connector on harness going to the panel). Set multimeter for 50 vdc, red lead to J13C, black lead to ground.

If 24 volts is not present, harness between J13 and J5 is defective. If 24 volts is present, harness between J13 and heater fuel pump is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 7. Disconnect J6 from control box. Check for 24 volts at J6C. Multimeter set for 50 vdc, red lead to J6C (control box connector).

If 24 volts is not present, replace or repair defective heater control box (para 2-75*f*). If 24 volts is present, proceed to step 8.

Step 8. Remove cover on personnel heater (para 2-180). Check for 24 volts at terminal #2. Connect red lead to terminal #2, black lead to ground.

If 24 volts exist, proceed to step 10. If not, proceed to step 9.

Step 9. Remove J30 from heater. Check J30C (harness connector) for 24 volts. Set multimeter for 50 vdc, red lead to J30C, black lead to ground.

If 24 volts exist, replace defective heater (para 2-180). If 24 volts does not exist, harness between J30 and J6 is defective. Inspect connectors for bent or dirty contacts. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 10. Turn heater control box to OFF position. Check for continuity through the normally open terminals of flame switch.

If continuity does not exist, replace defective flame detect switch (para 2-180).

2. HEATER MOTOR OPERATES (AUDIBLE) BUT HEATER WILL NOT START (NO HEAT) (CIRCUIT 404).

Turn heater control to OFF position. Remove cover on heater (para 2-180). Disconnect igniter lead from igniter control. With multimeter set on RX1 scale, check for continuity from igniter lead to ground.

If continuity does not exist, replace defective igniter (para 2-180). If continuity does not exist, replace flame detector switch (para 2-180).

3. MOTOR CONTINUES TO RUN SLOW LONG AFTER IGNITION BEGINS (AUDIBLE). HEATER GOES OUT WHEN SWITCH IS TURNED FROM START TO RUN (CIRCUIT 402, 404, 407).

Replace defective flame detector switch (para 2-180).

4. HEATER WILL ONLY OPERATE AT LOW SPEED (CIRCUIT 401).

Step 1. Place heater control switch in OFF position. Disconnect J6 from control box. With multimeter on RX1 scale, check for continuity from J6B to J6E (connector on control box) with heater switch in HI position.

Table 2-20. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

If continuity does not exist, replace defective heater control box (para 2-75*f*). If continuity does exist, proceed to step 2.

Step 2. Disconnect J30 from heater. With multimeter set on RX1 scale, check for continuity from J30B (harness connector) to J6B (harness connector to control box).

If continuity does exist, replace heater (para 2-180). If continuity does not exist, harness between J30 and J6 is defective. Inspect connector for bent or dirty contacts. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

5. HEATER WILL NOT SHUT OFF OR RUNS EXCESSIVELY AFTER HEATER HAS BEEN TURNED TO OFF POSITION (RUNS OVER 3-½ MINUTES).

Replace defective flame detector switch (para 2-180).

6. HEATER OVERHEATS AND STOPS BURNING.

Check for air flow restrictions.

If no restrictions are present, replace heater (para 2-180).

7. HEATER OVERHEATS BUT CONTINUES TO BURN.

Replace heater (para 2-180).

Table 2-21. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

TRANSMISSION RETARD AND TRAILER BRAKE SYSTEM

DESCRIPTION: The transmission retard and brake switch is a foot operated switch. When depressed, two solenoids are activated simultaneously to aid in braking the engine and trailer. This braking action improves vehicle control in adverse weather, cornering or hilly grades. When the foot switch is used, the transmission retard solenoid, located on the right side of the transmission, is activated. This initiates a flow of oil which hydraulically slows the transmission. An electrical signal is also sent to the trailer magnet valve. An air presssure of 15 psi acts on the brakes. Through this system, 10% of the trailer's braking power is applied. When the spring loaded switch is released, the retard solenoid and trailer magnet valve become deactivated, returning the system to normal operation (fig. 2-33).

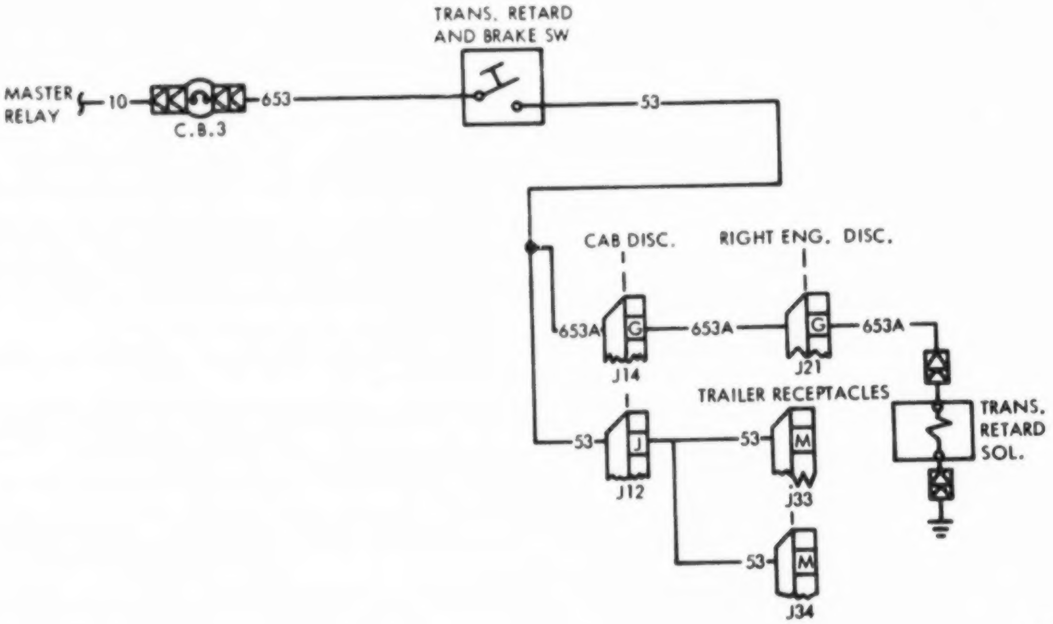

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Figure 2-33. Transmission and trailer brake retarder switch electrical schematic.

Table 2-21. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

PRELIMINARY CHECKS: If the malfunction is not evident (whether trailer brake and/or transmission retard solenoid is operative), these preliminary checks should be made first.

a. Start engine and let idle. Disconnect J33 and J34 from the goose neck. Set multimeter to read voltage (50 vdc). Connect black lead to ground and red lead to J33M (first check) and then to J34M (repeat check).

b. Depress the foot switch (transmission retard/brake switch). Engine should slow down and multimeter should read at least 24 volts.

(1) If meter reads 24 volts at both connectors, and engine does not slow down, proceed to step 7.

(2) If engine slows, but meter does not read 24 volts at both connectors, proceed to troubleshooting procedure, malfunction 2, step 1.

(3) If engine does not slow and meter does not read 24 volts at both connectors, proceed to troubleshooting procedure, malfunction 1, step 1.

NOTE

Turn engine off after preliminary checks.

NOTE

Before troubleshooting the electrical system, verify correct air pressures in the tractor/trailer systems. See operators manual TM 9-2320-258-10.

1. TRANSMISSION RETARD BRAKE SWITCH (FOOT SWITCH) INOPERATIVE CIRCUIT 653).

Step 1. Turn master switch in ON position. Disconnect wire 653 from transmission retard/brake switch (located on floor). Check for 24 volts from wire 653. Connect red lead of multimeter to wire 653 and black lead to ground.

If 24 volts exist, reconnect and proceed to step 4. If 24 volts does not exist, proceed to step 2.

Step 2. Disconnect wire 653 from circuit breaker 3. Connect red lead to C.B. connector and black lead to ground. Check for 24 volts.

If 24 volts does not exist, reconnect and proceed to step 3. If 24 volts does exist, harness between circuit breaker 3 and foot switch is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 3. Disconnect wire #10 from circuit breaker 3. Connect red lead of the multimeter to wire #10, black lead to ground, and check for 24 volts.

If 24 volts is present, replace defective circuit breaker #3. If 24 volts is not present, harness between master switch and C.B. 3 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 4. Disconnect wire 53 from foot switch. Check connector from switch for 24 volts. Connect red lead of multimeter to connector 53 and black lead to ground.

If 24 volts is present, reconnect and proceed to both malfunction 2, step 1 and malfunction 3, step 1. If 24 volts is not present, replace defective foot switch (para 2-85).

2. TRAILER BRAKES INOPERATIVE, BUT TRANSMISSION RETARD SOLENOID DOES OPERATE (CIRCUIT 53).

Step 1. Place master switch in ON position. Depress foot switch for remainder of test. With a multimeter set for 50 vdc, check for 24 volts at gooseneck connectors J33 and J34. Connect red lead to J33M and black lead to ground. Then move red lead to J34M.

If 24 volts exist at both connectors, malfunction is in trailer. See electrical troubleshooting in trailer TM 9-2330-294-14. If 24 volts does not exist at both conectors, proceed to step 2.

Step 2. Disconnect J12 from cab disconnects. Check for 24 volts from connector going towards cab. Connect red lead to J12J and black lead to ground.

If 24 volts does not exist, harness between foot switch and J12 is defective. If 24 volts exist, harness from J12 to J33 and J34 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any malfunction is evident, or cannot be determined, notify supporting maintenance.

3. TRANSMISSION RETARD SOLENOID INOPERATIVE BUT TRAILER BRAKES DO NOT OPERATE (CIRCUIT 635A).

Step 1. Turn master battery in ON position. Depress foot switch for remainder of test. Disconnect wire 653A from transmission retard solenoid. Check for 24 volts from the wire 653A to ground. Set multimeter for 50 vdc, red lead to wire 653A, (connector going to right engine disconnect) and black lead to ground.

If 24 volts exist, proceed to step 2. If 24 volts does not exist, proceed to step 3.

Step 2. Disconnect ground wire from transmission retard solenoid. Check for continuity to ground from connector which goes to ground. Set multimeter or RX1 scale, red lead to connector, black lead to ground.

If continuity exists, notify support personnel to replace defective transmission retard solenoid. If continuity does not exist, harness between connector tested and ground is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 3. Disconnect J21 from right engine disconnect. Check for 24 volts on harness connector going toward cab. Connect red lead to J21G, black lead to ground.

If 24 volts does not exist, proceed to step 4. If 24 volts does exist, harness between J21 and transmission retard solenoid is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 4. Disconnect J14 from cab disconnect. Check for 24 volts on harness connector going towards panel. Connect red lead to J14G, and black lead to ground.

If 24 volts does not exist, harness between foot switch and J14 is defective. If 24 volts does exist, harness between J14 and J21 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-22. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

FUEL SHUTOFF AND AUXILIARY FUEL PUMP SYSTEMS

DESCRIPTION. The fuel shutoff switch is used to turn the engine off. The power comes from the starter switch directly to the fuel shutoff switch. When the spring loaded switch is depressed, circuit 54 is energized. This circuit energizes the fuel shutoff solenoid, which cuts off the engine fuel supply (fig. 2-34). The auxiliary fuel pump is used when higher fuel pressure is needed (cold weather starts, purging the fuel system). The pump is electrically operated when energized through circuit 76B. This circuit is energized when the auxiliary fuel pump switch is in the ON position. Power to this switch comes from the master switch, through circuit breaker #6 and to the switch via circuit 76A.

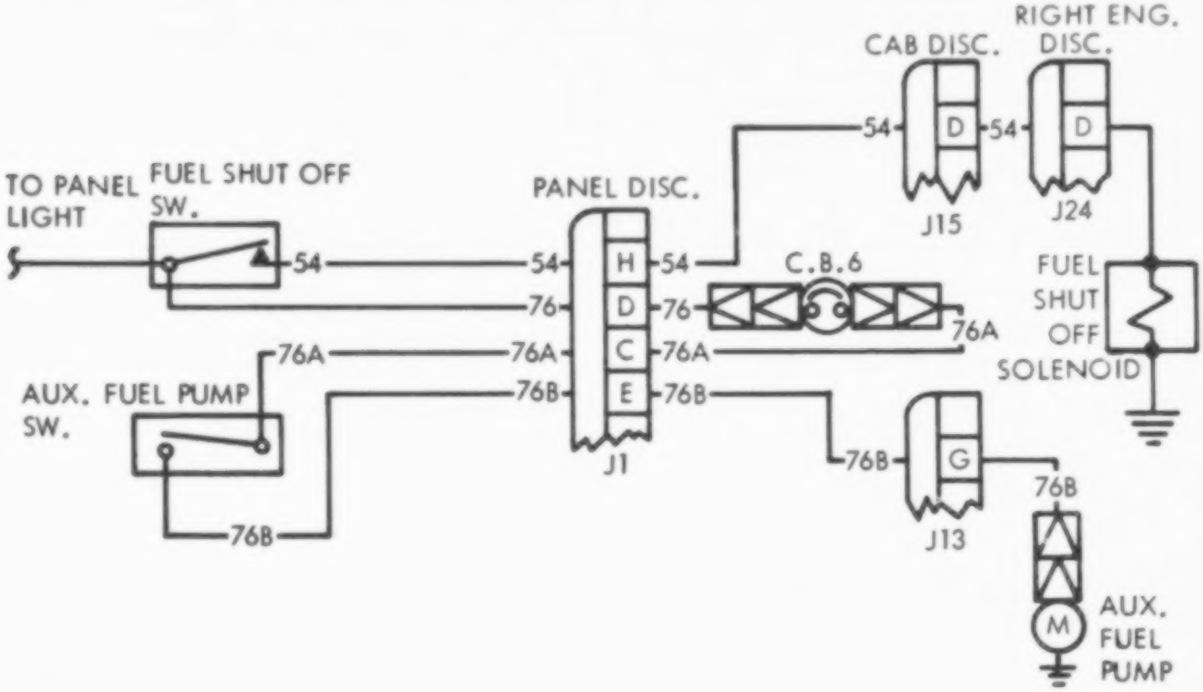


Figure 2-34. Auxiliary fuel pump and fuel shutoff electrical schematic.

1. AUXILIARY FUEL PUMP INOPERATIVE (CIRCUITS 76, 76A, 76B).

Step 1. Place starter switch and auxiliary fuel pump switch in ON position. Check for 24 volts from terminals of auxiliary fuel pump switch to vehicle ground. Multimeter set for 50 vdc, red lead to terminals, black to ground.

If both terminals have 24 volts present, proceed to step 2. If only one has 24 volts present, replace defective auxiliary fuel pump switch (para 2-74*d*). If neither terminal has 24 volts present, proceed to step 5.

Step 2. Disconnect wire #76B from auxiliary fuel pump. Set multimeter for 50 vdc, red lead wire 76B, black lead to ground.

If 24 volts is present at wire 76B, replace defective auxiliary fuel pump (para 2-43). If not, proceed to step 3. (Reconnect wire to pump.)

Step 3. Disconnect J13 from cab disconnect. Check for 24 volts from J13G on connector which goes to panel. Connect red lead to J13G and black lead to ground.

If 24 volts is not present, reconnect and proceed to step 4. If 24 volts is present, harness between J13 and auxiliary fuel pump is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Disconnect J1 at panel. Check for 24 volts from J1E (connector on panel) to ground. Set multimeter for 50 vdc, red lead to J1E, black lead to ground.

If 24 volts is present, harness between J1 and J13 is defective. If 24 volts is not present, harness between J1 and auxiliary fuel pump switch is defective. Inspect connectors for bent or dirty contacts.Make necessary repairs.If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 5. Disconnect wire 76A from terminal of C.B. 6. Set multimeter for 50 vdc, red lead to C.B. terminal which wire was removed, black lead to ground.

24 volts should be present. If not, proceed to step 6. If present, proceed to step 8.

Step 6. Disconnect wire 76 from terminal of C.B. 6. Check for 24 volts from this wire to vehicle ground.

If 24 volts exist, replace defective circuit breaker. If 24 volts does not exist, proceed to step 7.

Table 2-22. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

Step 7. Disconnect J1 from panel and check J1D (connector on panel) for 24 volts. Set multimeter for 50 vdc, connect red lead to J1D, black lead to ground.

If 24 volts is present, harness between J1 and C.B. 6 is defective. If 24 volts is not present, harness between master switch and J1 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 8. Disconnect J1 from panel. Check for continuity from wire 76A (from C.B. 6) to J1C (connector on harness). Set multimeter on RX1 scale.

If continuity exists, harness between J1 and auxiliary fuel pump switch is defective. If continuity does not exist, harness between C.B.6 and J1 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

2. ENGINE WILL NOT STOP WHEN USING FUEL SHUTOFF SWITCH (CIRCUITS 76, 54).

Step 1. Place master switch in ON position. Depress and hold fuel shutoff switch for remainder of ALL test. Check for 24 volts at fuel shutoff solenoid. Set multimeter for 50 volts, red lead to solenoid terminal, black lead to ground.

If 24 volts exist, replace defective fuel shutoff solenoid (para 2-63). If not, proceed to step 2.

Step 2. Check for 24 volts from both terminals of fuel shutoff switch. Set multimeter for 50 volts. Connect red lead to terminals, black lead to ground.

If 24 volts exist at both terminals,proceed to step 3. If 24 volts exist at only one terminal, replace defective engine stop switch (para 2-74*d*). If 24 volts does not exist at either terminal, harness between master switch and fuel shutoff switch is defective. Inspect harness and connectors for bent or dirty contacts. Make necessary repairs or notify support personnel.

Step 3. Disconnect J1 at panel. Set multimeter for 50 volts, and check for 24 volts at panel connector J1H.

If 24 volts is present, proceed to step 4. If not, harness between fuel shutoff and panel disconnect is defective. Inspect harness and connectors for damaged, loose or dirty contacts. Make necessary repairs or notify support personnel.

Step 4. Reconnect J1 on panel and disconnect J15 at cab disconnect. Check for 24 volts at J15D (connector on harness from panel). Set multimeter for 50 vdc, red lead to J15D and black lead to vehicle ground.

If 24 volts is present, reconnect and proceed to step 5. If not, harness between panel disconnect J1 and cab disconnect J15 is is defective. Inspect for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 5. Disconnect J24 from right side of engine. Check contact D of harness connector for 24 volts. Set multimeter for 50 vdc, red lead to J24D, black lead to vehicle ground.

If 24 volts exist, harness between J24 and fuel shutoff solenoid is defective. If not, harness between J24 and cab disconnect J15 is defective. Inspect for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-23. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

WINCH P.T.O. SYSTEM

DESCRIPTION: The electric circuitry of the winch power take-off is controlied by three-way switches (fig. 2-35). The P.T.O. solenoid is controlled from winch station. When the P.T.O. solenoid is energized, it serves two functions; hydraulic fluid is allowed in the P.T.O. unit which in turn drives the hydraulic pump for the winches, and a fluid signal is sent to the governor to govern the engine at about 1850 rpm. The power circuit (Circuit 471) comes from the master relay, through circuit breaker 2 and the two switches. The two switches utilize circuits 471, 471A, 471B and 471C to energize the P.T.O. solenoid.

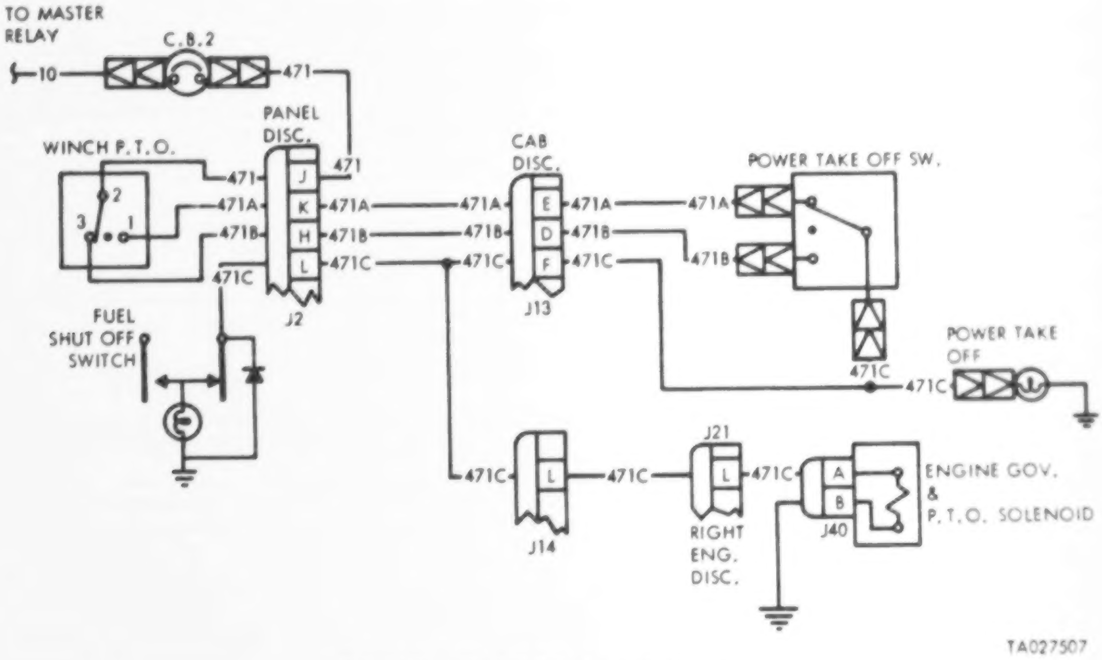


Figure 2-35. Winch P.T.O. electrical schematic.

1. **WINCH INOPERATIVE (CIRCUITS 471C, 471, 10, 471B).**

Step 1. Turn starter switch to ON position. Disconnect J40 from P.T.O. solenoid. With a voltmeter set for 50 vdc, place red lead to contact A of harness connector J40, black lead to ground, and check for 24 volts from J40A.

If no voltage is present, change switch positions in winch station. If 24 volts is present with switches in any position, replace defective P.T.O. solenoid (para 2-102). If 24 volts is not present, proceed to step 2.

Step 2. Disconnect wire #471 from C.B. 2. Place red lead of multimeter on circuit breaker terminal, and black lead to ground. Check for 24 volts from terminal.

If 24 vols is present, reconnect wire and proceed to step 4. If 24 volts is not present, proceed to step 3.

Step 3. Disconnect wire #10 from C.B. 2. Check for 24 volts from wire #10 to ground. Connect red lead to wire #10, black lead to ground.

If 24 volts is present, replace defective circuit breaker #2 (para 2-78). If 24 volts is not present, harness between C.B. 2 and master switch is defective. Notify supporting maintenance.

Step 4. Disconnect J2 from panel. Check the connector on the harness for 24 volts. Check with red lead to Contact J and black lead to ground.

If 24 volts is present, proceed to step 5. If 24 volts is not present, harness between J2 and C.B. 2 is defective. Inspect connectors for bent or dirty contacts. Make necessry repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 5. Reconnect J2 to panel. Check for 24 volts at terminal #2 of cab P.T.O. switch. Place red lead to terminal, black to ground.

If 24 volts exist, proceed to step 6. If 24 volts does not exist, harness between J2 and cab P.T.O. switch is defective (para 2-79). Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

Step 6. Place red lead of multimeter on terminal #3 of cab P.T.O. switch. Place the black lead to ground. Check for 24 volts from that terminal.

If 24 volts is not present, change switch position. If 24 volts is still not present, replace defective P.T.O. switch. If 24 volts is present, change switch position If 24 volts is still present, replace defective switch (para 2-74). If 24 volts is present in only one switch position, leave switch in position and proceed to step 7.

Step 7. Disconnect J2 from the panel and check contact H for 24 volts. Place red lead to J2H (panel connector) and black lead to ground.

If 24 volts is present, reconnect and proceed to step 8. If 24 volts is not present, harness between J2 and cab P.T.O. switch is defective (para 2-79).

Table 2-23. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 8. Disconnect wire 471C from P.T.O. switch in winch station (fig. 2-147). Check for 24 volts from connector on switch. Operate switch in both directions until 24 volts is present.

If 24 volts cannot be obtained, proceed to step 9. If 24 volts is present, leave switch in position, reconnect, and proceed to step 11.

Step 9. Disconnect wire 471B from winch station P.T.O. switch. Place red lead of multimeter to connector coming from cab, black lead to ground.

If 24 volts is present, replace defective P.T.O. switch in winch station (para 2-90). If 24 volts is not present, reconnect and proceed to step 10.

Step 10. Disconnect J13 from cab disconnect. Place red lead of multimeter to J13D (connector coming from cab) and black lead to ground.

If 24 volts is present, harness between J13 and P.T.O. switch in winch station is defective. If 24 volts is not present, harness between J13 and panel connector J2 is defective. Inspect connector for bent or dirty contacts. Make necessry repairs. If any other malfunction is evident, or cannot be detected, notify supporting maintenance to replace harness.

Step 11. Disconnect J13 from cab disconnect. Place red lead to J13F, the connector coming from winch station P.T.O. switch, and place black lead to ground.

If 24 volts is present, reconnect and proceed to step 12. If 24 volts is not present, harness between J13 and winch station P.T.O. switch is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 12. Disconnect J21 from right engine disconnect. Connect red lead to J21L on connector coming from cab.

If 24 volts is present, harness between J21 and P.T.O. solenoid is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance. If 24 volts is not present, proceed to step 13.

Step 13. Disconnect J14 from cab disconnect. Place red lead of multimeter to J14L on connector coming from panel, and black lead to ground.

If 24 volts is present, harness between J14 and J21 is defective. If 24 volts is not present, harness between J14 and J2 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

2. CANNOT CONTROL WINCH FROM ONE STATION (OTHER STATION OPERATIONAL).

Turn starter switch to ON position.

Start troubleshooting from malfunction 1, step 6.

3. INDICATOR LIGHT DOES NOT OPERATE WHEN WINCH IS OPERATING (WINCH STATION).

Check bulb. If defective, replace with new bulb. If still not on when winch is operational, remove wire 471C from indicator light. With winch turned on, place red lead of the multimeter on wire 471C, and black lead to ground.

If 24 volts is present, replace socket assembly (para 2-90). If 24 volts is not present, harness between P.T.O. switch and lamp is defective. Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-24. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

AIR HORN SYSTEM

DESCRIPTION: The air horn is electrically operated (fig. 2-36). Power comes from circuit breaker 1, through circuits 25 and 27. The air horn switch completes the circuit to ground when the horn button is depressed.

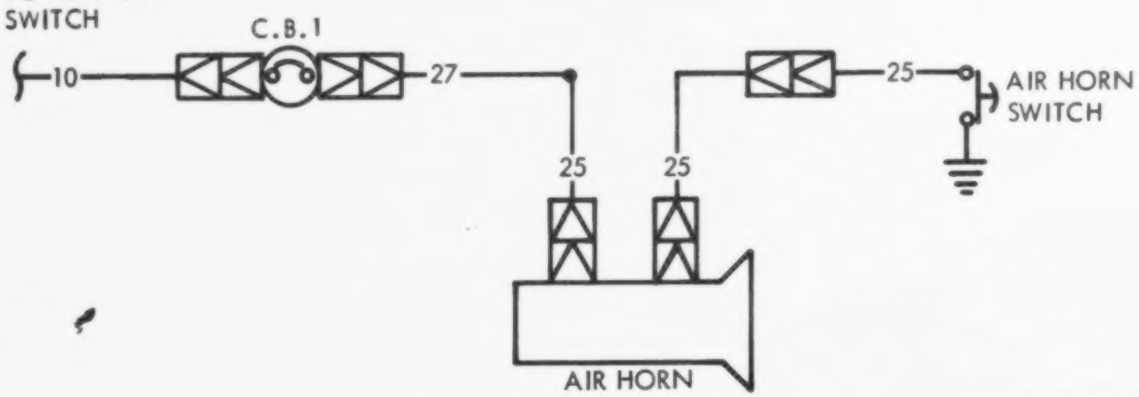


Figure 2-36. Air horn electrical schematic.

TA027508

Table 2-24. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

NOTE

Before troubleshooting air horn electrical system, assure system pressure is at least 50 psi and starter switch is in ON position. Check for any broken, bent or kinked air lines.

AIR HORN IS NOT OPERATIONAL.

Step 1. Place starter switch in ON position. Disconnect wire #25 (coming from C.B. 1) from air horn. Set multimeter for 50 vdc scale and check for 24 volts from wire #25 to vehicle ground. (Red lead to wire 25, black lead to ground.)

If 24 volts exist, proceed to step 2. If 24 volts does not exist, proceed to step 3.

Step 2. Disconnect remaining wire #25 on air horn. Check for continuity to ground, from this wire, while depressing horn button.

If continuity exists, replace defective air horn (para 2-83). If not, proceed to step 4.

Step 3. Disconnect wire #27 from C.B. 1. Check circuit breaker terminal for 24 volts. Set multimeter for 50 vdc scale, red lead to terminal, black to ground.

If 24 volts is not present, replace defective circuit breaker No. 1 (para 2-78). If 24 volts is present, harness between C.B. 1 and air horn is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Disconnect wire 25 from air horn button. Depress button and check for continuity from wire 25 (from air horn button) to ground.

If continuity does not exist, replace air horn button (para 2-135). If continuity does exist, harness between air horn and switch is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-25. Troubleshooting

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

WARNING BEACON AND TRAILER AUXILIARY OUTLET SYSTEM

DESCRIPTION: Electrical power for the warning beacon and the trailer auxiliary outlet is controlled by the B/O relay so that the light must be in "Stoplight" or "Service Drive" position and control switch must be ON to supply power to beacon or outlets (fig. 2-37). The warning beacon is a flashing amber caution light and is controlled by the beacon switch in the tractor cab. The trailer auxiliary outlets are provided for use with auxiliary equipment. Power to the outlets is supplied by the electrical connecting cable to the trailer. Power to the auxiliary outlets is controlled by the trailer auxiliary power switch.

1. NEITHER THE WARNING BEACON NOR THE TRAILER AUXILIARY POWER IS OPERATIVE (CIRCUITS 657, 37, 325).

Step 1. Place light switch in either STOPLIGHT or SERVICE DRIVE position. Operate turn signal switch and/or work lights.

If either operate, proceed to step 2. If neither operate, malfunction is in the light switch or B.O. relay. See troubleshooting Lighting System, table 2-26, malfunction 4.

Step 2. Disconnect J5 from panel. Check for 24 volts from the harness connector. Set the multimeter for 50 vdc, red lead to J5D, black lead to ground. Also check J5H for 24 volts to ground (black lead).

If 24 volts does not exist in both cases, proceed to step 3. If 24 volts exist in both cases, the harness between J5 and the rotating beacon switch is defective. If 24 volts exist in only one case, harness between J5 and circuit breaker 7 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Disconnect wire 325/37 from circuit breaker 7. Check the circuit breaker terminal for 24 volts. Connect the red lead to the terminal, and the black lead to ground.

If 24 volts does not exist, proceed to step 4. If 24 volts does exist, harness between J5 and the circuit breaker is defective. Inspect connectors for bent or dirty contacts. Make necessry repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Disconnect wire 657 from circuit breaker. Check for 24 volts from this wire. Connect red lead to wire 657, and black lead to ground.

If 24 volts exist, replace defective circuit breaker #7. If 24 volts does not exist, harness between circuit breaker and B.O. relay is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance to replace harness.

2. WARNING BEACON INOPERATIVE; TRAILER AUXILIARY POWER OPERATIVE.

NOTE

If it is not known if trailer auxiliary power is present, see step 1.

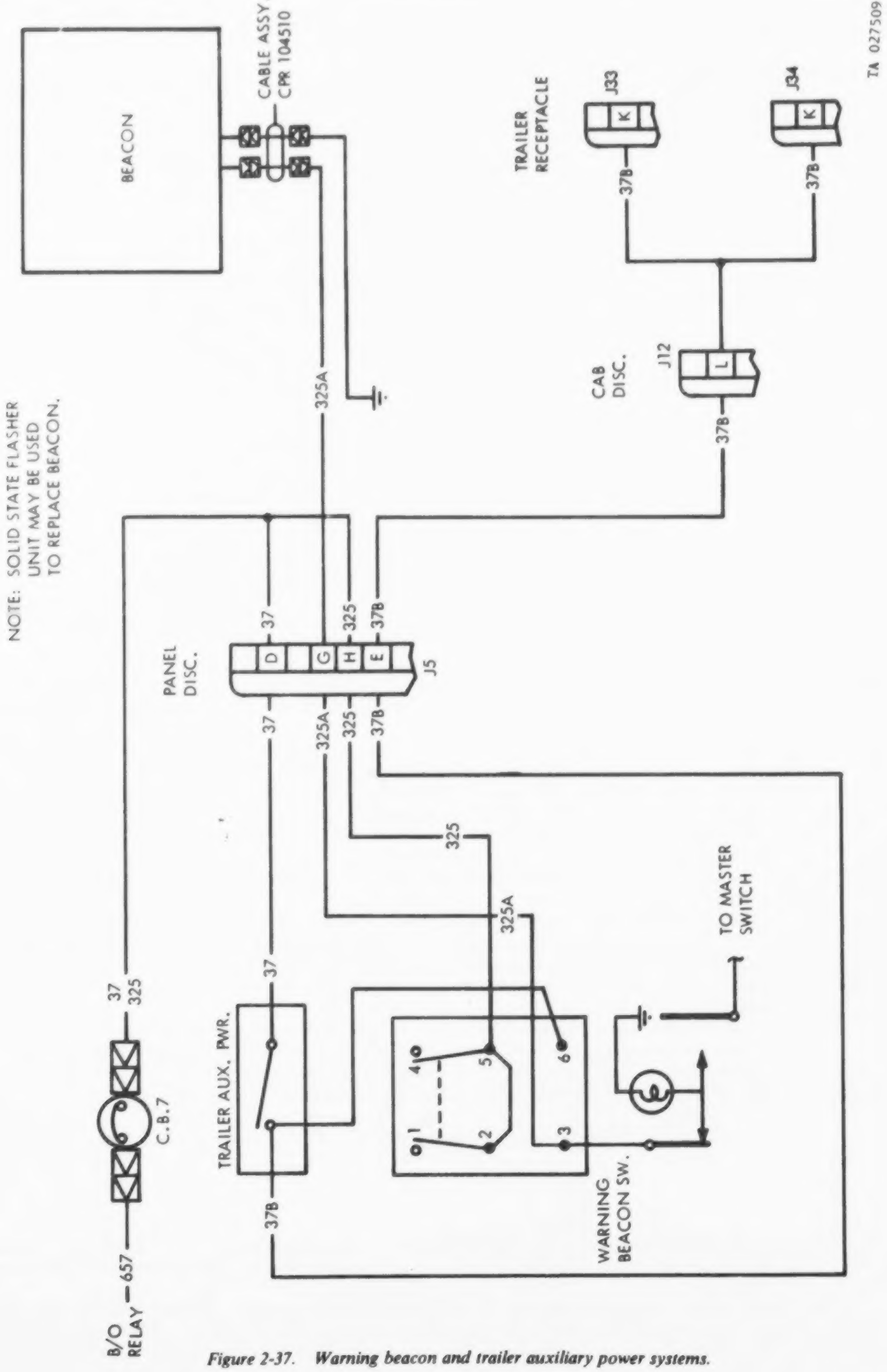
Step 1. Disconnect J33 from gooseneck connector. With multimeter set for 50 vdc, check for 24 volts from tractor connector. Connect red lead to J33K and black lead to ground. Turn auxiliary trailer power ON and place light switch in SERVICE DRIVE or SPOTLIGHT position.

If 24 volts is present, proceed to step 2. If 24 volts does not exist, proceed from malfunction 1, step 1.

Step 2. Turn the WARNING BEACON SWITCH in the ON position. Disconnect connectors at rotating beacon. Check for 24 volts from harness connector going to 325A. Connect red lead to circuit 325A connector, black lead to ground connector.

Table 2-25. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


TA 027509
BEACON
CABLE ASSY.
CPR 104510
TRAILER RECEPTACLE
J33
K
37B
J34
K
37B
CAB DISC.
J12
L
37B
325A
PANEL DISC.
J5
D
G
H
E
37
325
37B
37
325A
325
37B
325
325A
TO MASTER SWITCH
37
325
C.B.7
TRAILER AUX. PWR.
37B
1
2
3
4
5
6
WARNING BEACON SW.
B/O RELAY
657

NOTE: SOLID STATE FLASHER UNIT MAY BE USED TO REPLACE BEACON.

Figure 2-37. Warning beacon and trailer auxiliary power systems.

Table 2-25. Troubleshooting - Continued

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

If 24 volts is not present, proceed to step 3. If 24 volts is present, replace defective warning beacon assembly (para 2-71).

Step 3. Disconnect cable assembly (CPR104510) connectors below cab rear window and check for 24 volts. Connect red lead to circuit 325A connector, black lead to ground connector.

If 24 volts is not present, proceed to step 4. If 24 volts is present, notify supporting maintenance to replace cable assembly.

Step 4. Check for continuity from harness to ground. Set multimeter on RX1 scale. Connect one lead to ground connector, and other lead to ground.

If continuity exists, less than 1 ohm, proceed to step 5. If continuity does not exist, harness between cable assembly and ground contact is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 5. Disconnect J5 from panel. Check harness connector for 24 volts. Set meter for 50 vdc, red lead to J5H and black lead to ground.

If 24 volts is present, proceed to step 6. If 24 volts is not present, harness between J5 and circuit breaker is defective. Inspect connectors for bent or dirty contacts. Make necessry repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 6. Assure beacon switch is in ON position. Check for continuity from the panel connector. Set the multimeter on RX1 scale. Connect one lead to J5H and the other to J5G.

If continuity does not exist, reconnect J5 and proceed to step 7. If continuity exists, harness between J5 and J41 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 7. Connect the black lead of the multimeter to ground. Set the meter for 50 vdc. Assure warning beacon switch is ON. Check for 24 volts from terminals 5 and 6 of warning beacon switch. Connect red lead to terminal 5 and observe meter. Then proceed to do same on terminal 6.

If 24 volts is present on one of the terminals, and not the other, replace defective warning beacon switch (para 2-75c). If both terminals have 24 volts present, or both do not, harness between J5 and beacon switch is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

3. TRAILER AUXILIARY POWER NOT AVAILABLE WHILE BEACON IS OPERATIVE.

Step 1. Turn trailer auxiliary power switch in ON position. Place light switch in either SERVICE DRIVE or STOPLIGHT position. Disconnect J33 from gooseneck connector and check tractor connector for 24 volts. Set meter for 50 vdc, red lead to J33K and black lead to ground.

If 24 volts is not available, proceed to step 2. If 24 volts is present, malfunction is in trailer circuit. See TM 9-2330-294-14.

Step 2. Disconnect J5 from panel. With multimeter set on RX1 scale, check for continuity from panel connector. Connect one lead to J5D, and other to J5E. Assure trailer auxiliary power switch is in ON position.

If continuity exists, reconnect J5 and proceed to step 3. If continuity does not exist, proceed to step 4.

Step 3. Disconnect J12 at cab disconnect. Check for 24 volts at connector going towards panel. Set meter for 50 vdc, red lead to J121 and black lead to ground.

If 24 volts is present, harness between J12 and gooseneck connector J33 is defective. If 24 volts is not present, harness between J12 and J5 is defective. Inspect connectors for dirty or bent contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 4. Turn the light switch to the OFF position. Check for continuity across the trailer auxiliary power switch when the switch is in the ON position. Set the multimeter on the RX1 scale, red lead to one terminal and black lead to other terminal of switch.

If continuity does not exist, replace defective trailer auxiliary power switch (para 2-75c). If continuity does exist, harness between switch and J5 is defective. Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-26. Troubleshooting

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

LIGHTING SYSTEM

DESCRIPTION: Light circuits are controlled by the light switch on the instrument panel. Each light is connected to the light switch by connectors, wiring harnesses and cables; cables are identified by numbered tags near the end of each cable. The light circuits are energized from the battery through circuits 6 and 15 to terminal "F" on the light switch. Individual or groups of lights are selected by the light switch. When selected by the light switch, the stoplight is energized by an air-operated switch in the brake system, or by the directional signal system, which has an individual actuator/selector on the steering column. See figures 2-38, 2-39 and 2-40 for simplified electrical diagrams of lighting system.

To test the operation of the lighting system, refer to TM 9-2320-258-10 for operating instructions for the light switch.

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

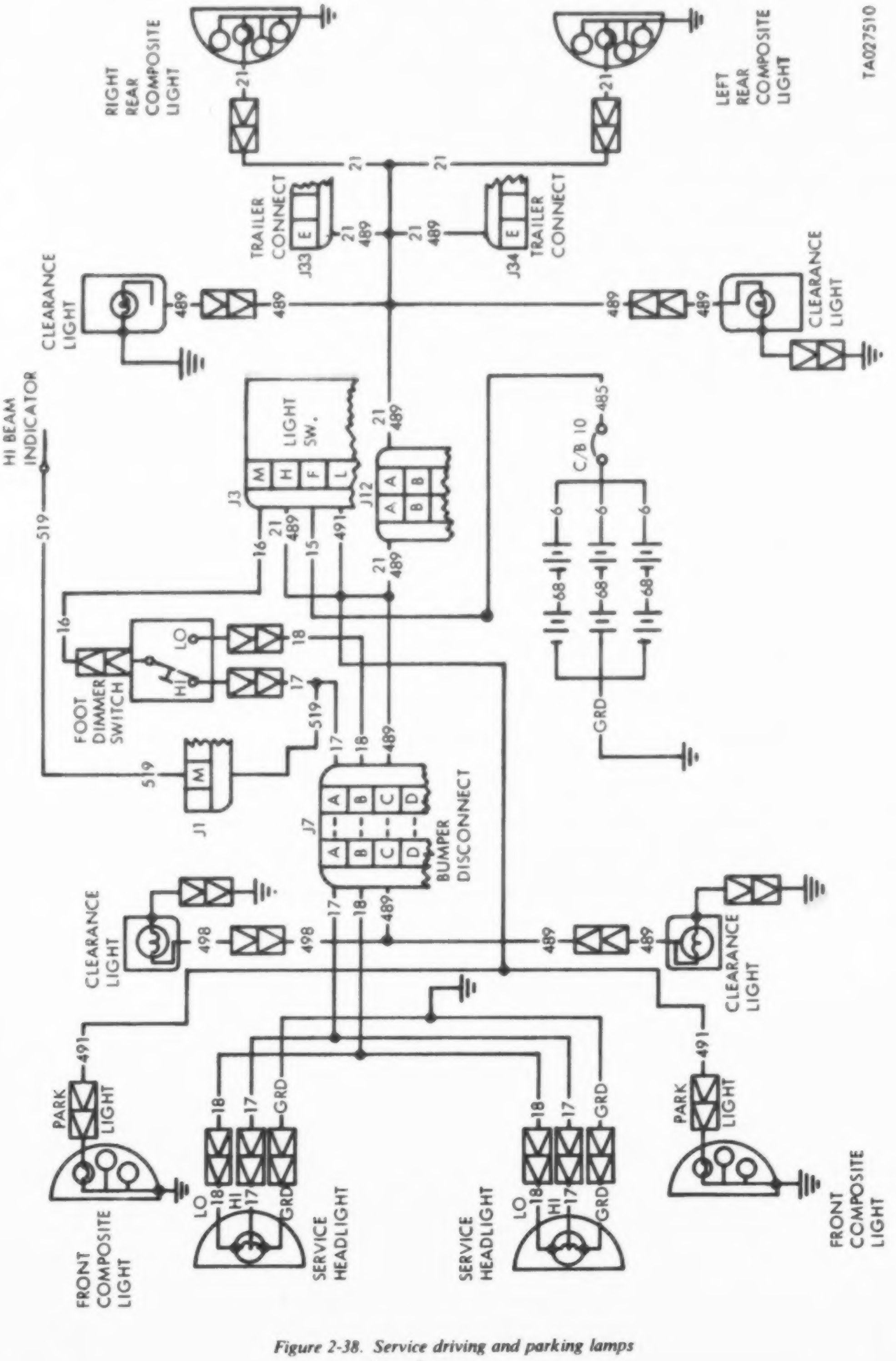

RIGHT REAR COMPOSITE LIGHT
LEFT REAR COMPOSITE LIGHT
TA027510
TRAILER CONNECT
J33
J34
CLEARANCE LIGHT
HI BEAM INDICATOR
LIGHT SW.
J3
M
H
F
L
J12
A
B
C/B 10
485
68
GRD
FOOT DIMMER SWITCH
LO
HI
J1
M
J7
C
D
BUMPER DISCONNECT
PARK LIGHT
FRONT COMPOSITE LIGHT
SERVICE HEADLIGHT
21
489
491
498
519
16
15
17
18
6

Figure 2-38. Service driving and parking lamps wiring diagram.

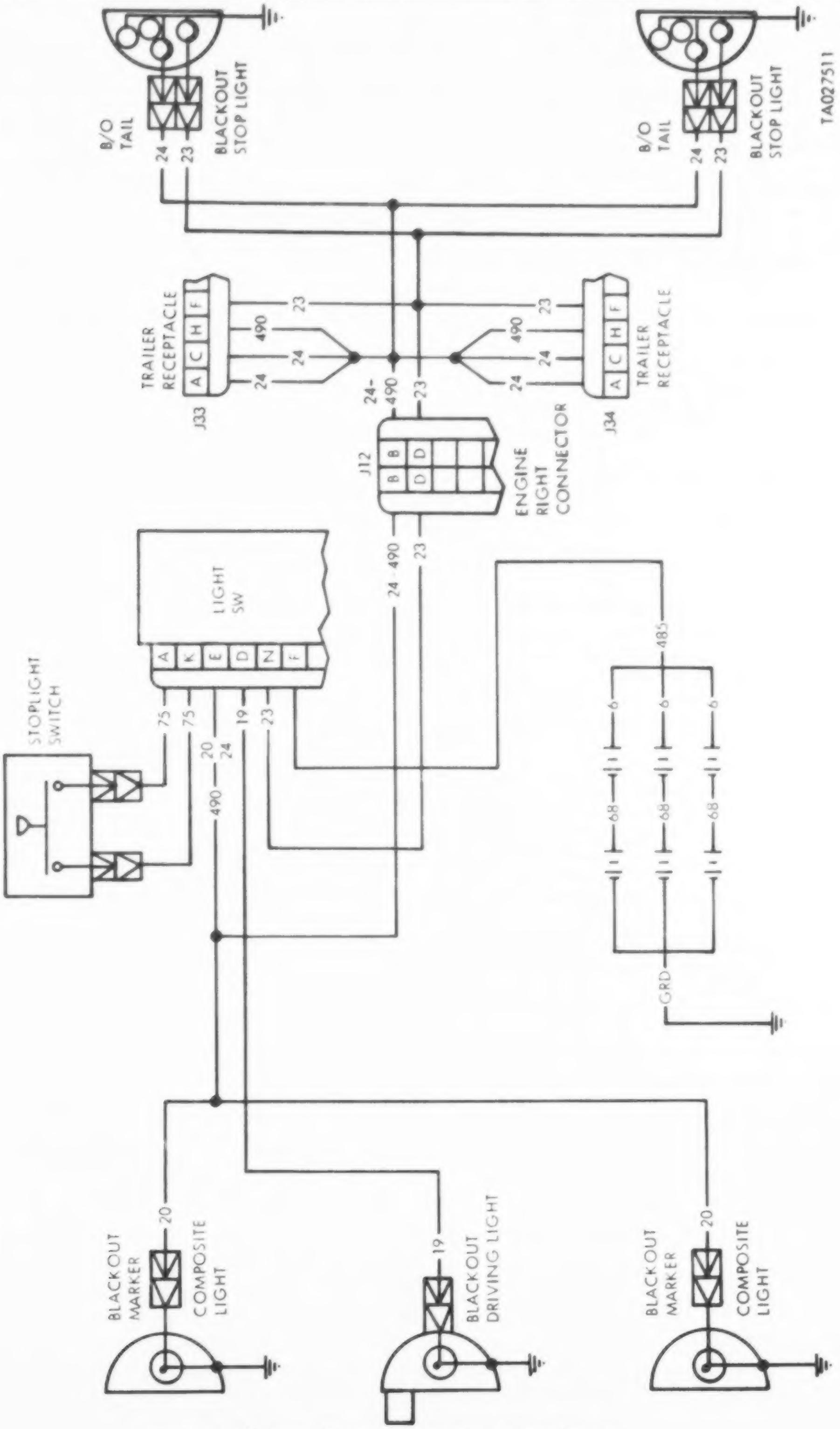

B/O TAIL
BLACKOUT STOP LIGHT
24
23
B/O TAIL
BLACKOUT STOP LIGHT
24
23
TA027511
TRAILER RECEPTACLE
J33
A
C
H
F
23
490
24
24
TRAILER RECEPTACLE
J34
A
C
H
F
23
490
24
24
24-490
23
J12
B
B
D
D
ENGINE RIGHT CONNECTOR
24 490
23
LIGHT SW
A
K
E
D
N
F
STOPLIGHT SWITCH
75
75
20
24
19
23
490
485
6
6
6
68
68
68
GRD
20
BLACKOUT MARKER
COMPOSITE LIGHT
19
BLACKOUT DRIVING LIGHT
20
BLACKOUT MARKER
COMPOSITE LIGHT

Figure 2-39. Blackout drive and marker circuit wiring diagram.

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

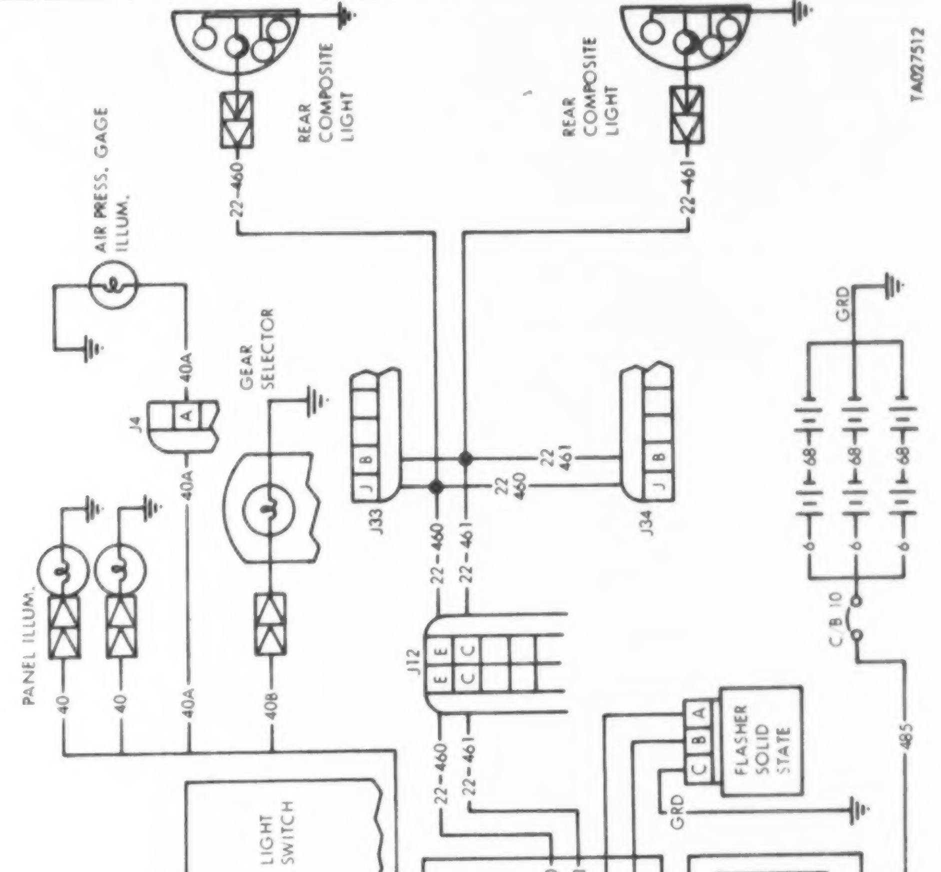

REAR COMPOSITE LIGHT
22-460
REAR COMPOSITE LIGHT
22-461
TA027512
AIR PRESS. GAGE ILLUM.
40A
J4
A
GEAR SELECTOR
PANEL ILLUM.
40
40
40A
408
J33
J
B
22-460
22-461
22
460
22
461
J34
J
B
J12
E
E
C
C
GRD
6
68
C.B 10
485
FLASHER SOLID STATE
A
B
C
GRD
LIGHT SWITCH
J3
A
K
C
J
F
B
75
75
22
709
15
40
STOPLIGHT SWITCH
B/O RELAY COIL
X1
X2
DIRECTIONAL SIGNAL CONTROL UNIT
E
C
H
F
D
G
B
A
22-460
22-461
A
B
22
467
461
460
HAZARD WARNING POSITION
RIGHT TURN
OFF
LEFT TURN
A1
A2
B/O RELAY CONTACTS
485A
TURN SIGNAL
460
FRONT COMPOSITE LIGHT
460
TURN SIGNAL
461
FRONT COMPOSITE LIGHT
461

Figure 2-40. Panel illumination lights, directional signal and service stoplights wiring diagram.

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NOTE

Before troubleshooting the lighting system, refer to TM 9-2320-258-10 to become familiar with the lighting arrangement for each switch position and the nomenclature for each light.

1. GENERALLY UNSATISFACTORY LIGHTING (FLICKERING, DIM, FREQUENT BURNOUTS, INTERMITTENT) (CIRCUITS 6, 68, 15, 16, 17, 18, 21, 489, 491).

Step 1. Perform a visual inspection. Inspect connections at light switch and each individual light. Inspect all ground connections at light assemblies.

If grounds are corroded or dirty, remove ground wire, scrape metal until clean and reconnect, tightening securely. After tightening, coat area with rust-reducing compound. If malfunction is short lamp life, or frequent burnout of lamps, check for high generating system voltage (table 2-29), loose lamp housings or operating components that would cause excessive vibration. Before discarding a lamp that has been removed, test it in another light socket, or with an ohmmeter to determine whether lamp or socket is at fault.

NOTE

The following voltage tests may be performed with either the multimeter, or the voltmeter section of the low voltage circuit tester.

2. HEADLIGHT (ONE SIDE) INOPERATIVE (CIRCUITS 17, 18, GRD).

Step 1. Perform service headlight connector voltage test. Disconnect connector of malfunctioning headlight and connect voltmeter as shown in A, figure 2-41. Turn lighting switch to SER DRIVE position. If no voltage is indicated, operate dimmer switch. If no reading is indicated in either position of dimmer switch, wiring harness from headlamp to bumper connecter J7 is defective.

Inspect connectors for bent or dirty contacts and make necessary repairs. If any other malfunction is evident or cannot be determined, notify support maintenance to replace harness.

Step 2. If 24 volts is indicated, make a resistance test of lamp unit. Turn light switch to OFF. Connect multimeter between lamp terminals, GRD, and 18, as shown in B, figure 2-41. If multimeter needle moves past center of the scale, connect leads between terminals GRD and 17 and repeat. If replacement lamp unit does not light, inspect the pin connector or headlamp body for corrosion or loose connections.

If needle does not move in both tests, replace lamp. Clean corrosion and tighten loose connections.

3. HEADLIGHTS (BOTH SIDES) INOPERATIVE (CIRCUITS 16, 17, 18).

Step 1. Perform service headlamp voltage test (both sides). Check for voltage at connectors of both lamps as in A, figure 2-41. If voltage is not present, disconnect No. 17 and No. 18 wires at dimmer switch. Connect voltmeter as shown in C, figure 2-41. Check for voltage at exposed terminal No. 17 of selector switch. If voltage is not present, actuate switch. Repeat this step for exposed terminal No. 18 of the selector switch. If 24 volt reading is indicated at No. 17 and No. 18 switch terminals, but not at headlamp connectors, wiring harness from headlamps to dimmer switch is defective. See figure 2-38 for correct harness.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 2. If voltage readings are not present at No. 17 and No. 18 selector switch terminals, remove No. 16 wire and connect the positive lead of voltmeter to the No. 16 wire (not the selector switch terminals) to see if supply voltage is present. If no voltage is indicated, perform lighting switch connector voltage test (malfunction 9 Test or Inspection method) to determine if wiring harness from selector switch to lighting switch, or light switch itself, is defective.

If 24 volts is indicated, replace the dimmer switch (para 2-86).

4. BLACKOUT AND MARKER LIGHTS INOPERATIVE (CIRCUITS 19, 20, 24, 490).

Perform front blackout lamp connector voltage test. Connect voltmeter as shown in A, figure 2-42. Turn light switch to BO DRIVE position.

If 24 to 28 volts is indicated, replace bulb (para 2-68).

If new bulb does not light, check for corroded, dirty or defective socket and wire assembly. If no reading is indicated, perform lighting switch connector voltage test (malfunction 9 Test or Inspection method) to determine if wiring harness, or light switch is defective.

5. REAR LIGHTS INOPERATIVE (ANY ONE) (CIRCUITS 21, 22, 460, 461, 53, 24).

Perform rear lamp connector voltage test. Connect meter as shown in B, figure 2-42. Turn lighting switch to position corresponding to position of faulty rear lamp; if stoplight, depress brake pedal.

If 24 to 28 volts is indicated, replace bulb (para 2-69); if new bulb does not light, check for corroded, dirty or defective socket and wire assembly. If no voltage reading is indicated, perform lighting switch connector voltage test (malfunction 9 Test or Inspection method) to determine if wiring harness or light switch is defective.

6. ONE OR MORE TRAILER LIGHTS OUT (TRAILER RECEPTACLE INOPERATIVE) (CIRCUITS 21-489, 22-460, 22-461, 23, 24, 490, 90).

Perform trailer connector voltage test. Turn lighting switch to position which should light trailer lamp. Connect voltmeter (as shown in A, figure 2-43) to appropriate connector socket of inoperative circuit. If 24 to 28 volts is indicated at correct connector socket, check the No. 90 wire ground connection. If No. 90 wire is tightly grounded, trailer electrical system is faulty.

Conduct test at other trailer connector; if voltage is correct at one connector, trouble is in harness from main vehicle harness to connector or a loose contact at connector. If voltage readings are incorrect at both connector sockets, perform the cab disconnect voltage test (malfunction 7 Test or Inspection method).

7. ALL OR SOME OF FRONT OR REAR LAMPS INOPERATIVE (THIS TEST IS TO DETERMINE IF CAUSE OF FAILURE IS LIGHTING SWITCH OR WIRING HARNESS) (REAR LIGHTS - CAB DISCONNECT - CIRCUITS 21, 489, 22-461, 22-460, 23, 24-490, 75) (FRONT LIGHTS - BUMPER DISCONNECT - CIRCUITS 17, 18, 489).

Perform bumper/cab disconnect voltage test. Remove front or rear cab disconnect (depending on where defective lights are located) and inspect for corrosion, loose or dirty connections. Connect voltmeter (as shown in B, figure 2-43) to connector pin or socket which corresponds to defective circuit. Operate light switch to position which should light faulty circuit. If 24 to 28 volts is indicated, harness from switch to disconnect connector is in good condition.

Inspect harness from bumper/cab disconnect to individual light for breaks or loose connections. However, if no voltage

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

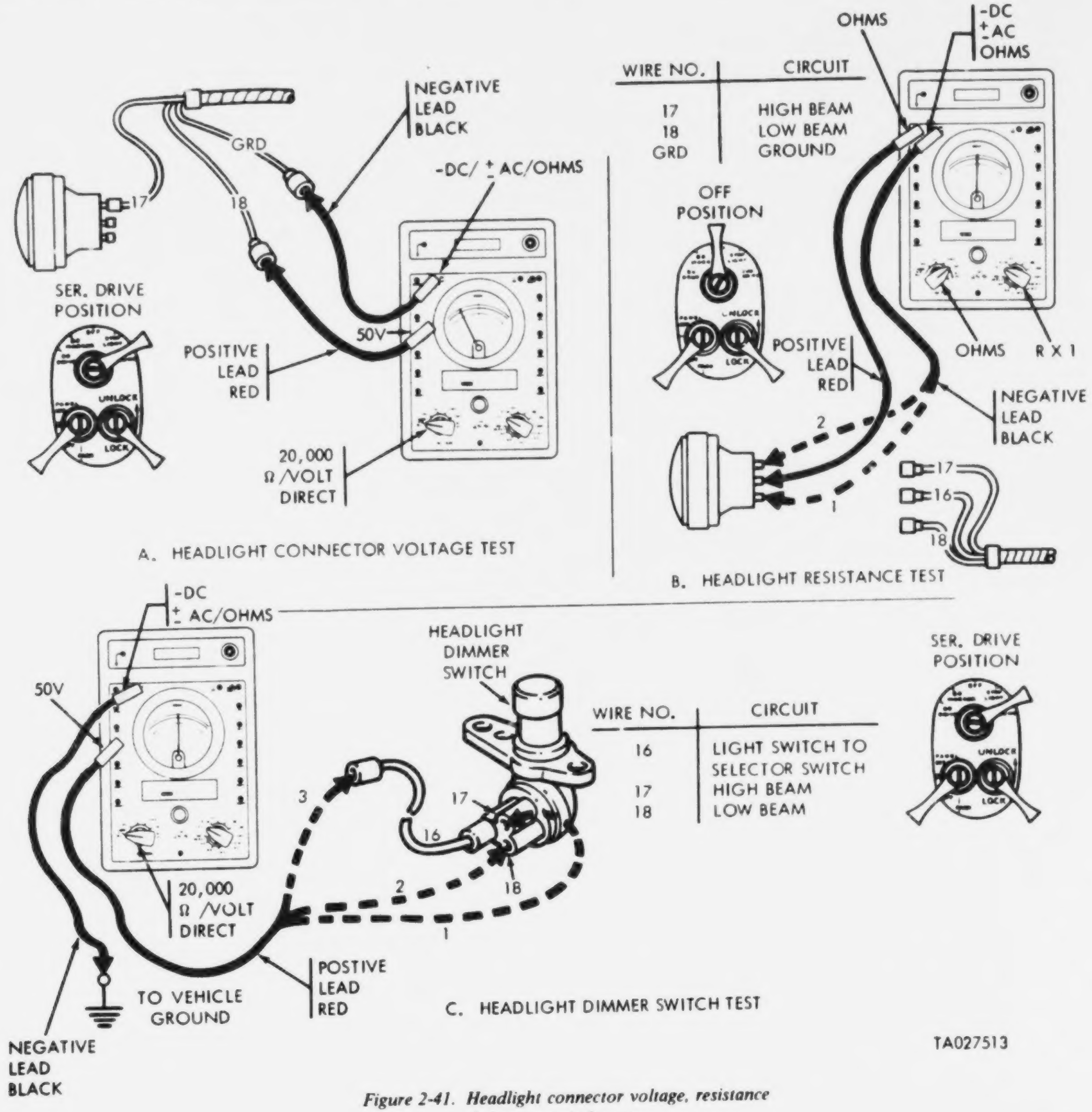

NEGATIVE LEAD BLACK
GRD
-DC/ ± AC/OHMS
17
18
SER. DRIVE POSITION
POSITIVE LEAD RED
50V
20,000 Ω /VOLT DIRECT
A. HEADLIGHT CONNECTOR VOLTAGE TEST
WIRE NO. | CIRCUIT
17 | HIGH BEAM
18 | LOW BEAM
GRD | GROUND
OHMS
-DC ± AC OHMS
OFF POSITION
POSITIVE LEAD RED
OHMS
R X 1
NEGATIVE LEAD BLACK
2
1
17
16
18
B. HEADLIGHT RESISTANCE TEST
-DC
± AC/OHMS
HEADLIGHT DIMMER SWITCH
50V
WIRE NO. | CIRCUIT
16 | LIGHT SWITCH TO SELECTOR SWITCH
17 | HIGH BEAM
18 | LOW BEAM
SER. DRIVE POSITION
3
17
16
2
18
1
20,000 Ω /VOLT DIRECT
POSTIVE LEAD RED
TO VEHICLE GROUND
NEGATIVE LEAD BLACK
C. HEADLIGHT DIMMER SWITCH TEST
TA027513

Figure 2-41. Headlight connector voltage, resistance and dimmer switch tests.

reading is obtained for this test, perform light switch voltage test (malfunction 9 Test or Inspection method). If spotlight circuit is faulty, perform stoplight switch test (malfunction 8 Test or Inspection method) and refer to directional signal tests (table 2-27, malfunction 1, step 1).

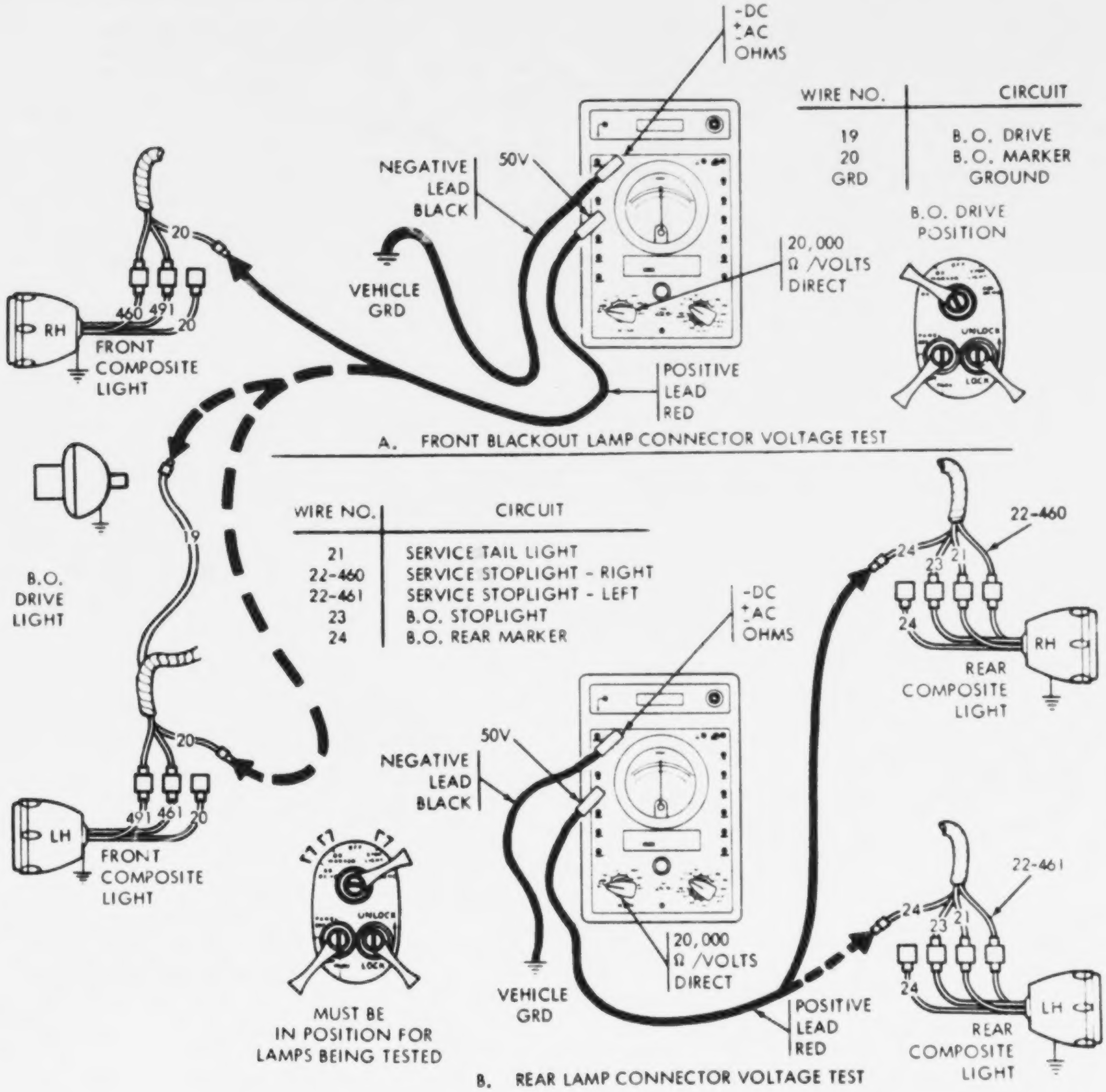
8. STOPLIGHT INOPERATIVE (STOPLIGHT SWITCH TEST) (CIRCUIT 75).

Perform stoplight switch voltage test. Move lighting switch to STOPLIGHT position. Disconnect connector from stoplight switch. Connect voltmeter as shown in A, figure 2-44. Check for voltage at one of two No. 75 wires. If voltage is indicated, connect that wire to one terminal of stoplight switch. With brake pedal depressed, use positive voltmeter lead to check for voltage at exposed stoplight switch terminal. If 24 to 28 volts is indicated, stoplight switch is serviceable.

If no reading is indicated, stoplight switch is faulty; replace stoplight switch (fig. 2-190). If no reading is indicated at either of two No. 75 wires, perform lighting switch connector voltage test (malfunction 9 Test or Inspection method) to determine if wiring harness or lighting switch is defective.

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


-DC
±AC
OHMS
NEGATIVE LEAD BLACK
50V
20
460
491
20
RH
FRONT COMPOSITE LIGHT
VEHICLE GRD
20,000 Ω /VOLTS DIRECT
POSITIVE LEAD RED
B.O. DRIVE POSITION
UNLOCK
LOCK
A. FRONT BLACKOUT LAMP CONNECTOR VOLTAGE TEST
19
B.O. DRIVE LIGHT
20
491
461
20
LH
FRONT COMPOSITE LIGHT
MUST BE IN POSITION FOR LAMPS BEING TESTED
-DC
±AC
OHMS
50V
NEGATIVE LEAD BLACK
VEHICLE GRD
20,000 Ω /VOLTS DIRECT
POSITIVE LEAD RED
22-460
24
23
21
24
RH
REAR COMPOSITE LIGHT
22-461
24
23
21
24
LH
REAR COMPOSITE LIGHT
B. REAR LAMP CONNECTOR VOLTAGE TEST
TA027514

WIRE NO.	CIRCUIT
19	B.O. DRIVE
20	B.O. MARKER
GRD	GROUND

WIRE NO.	CIRCUIT
21	SERVICE TAIL LIGHT
22-460	SERVICE STOPLIGHT - RIGHT
22-461	SERVICE STOPLIGHT - LEFT
23	B.O. STOPLIGHT
24	B.O. REAR MARKER

Figure 2-42. Front and rear blackout lamp connector voltage tests.

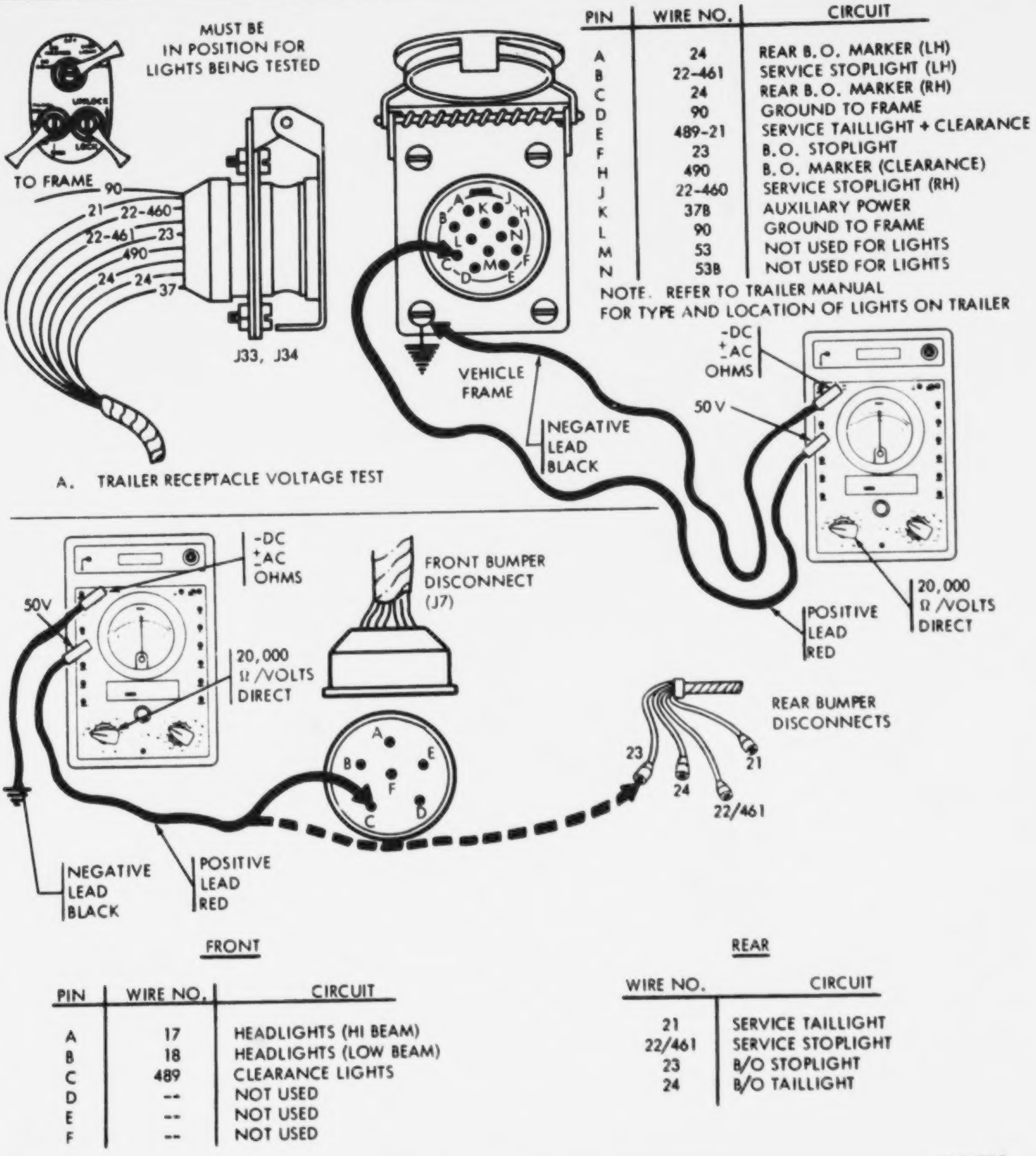
9. LAMPS WILL NOT LIGHT (SOME LAMPS WILL NOT LIGHT). (CIRCUITS 6, 15, 19, 21-489, 20-24-490, 22, 40, 75, 709, 460, 461).

Perform lighting switch connector voltage test. Remove lighting switch from dash panel and disconnect harness connector. Connect voltmeter between vehicle frame and socket "F" of lighting switch harness as shown in B, figure 2-44). If 24 to 28 volts is not indicated, check wiring harness circuits Nos. 6 and 15 from battery to lighting switch for broken wires or loose connections. If 24 to 28 volts is indicated on

best copy available

Table 2-26. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


MUST BE IN POSITION FOR LIGHTS BEING TESTED
TO FRAME
90
21
22-460
22-461
23
490
24
24
37
J33, J34
A
B
C
D
E
F
H
J
K
L
M
N
VEHICLE FRAME
NEGATIVE LEAD BLACK
-DC
+AC
OHMS
50 V
POSITIVE LEAD RED
20,000 Ω /VOLTS DIRECT
-DC
+AC
OHMS
50V
20,000 Ω /VOLTS DIRECT
FRONT BUMPER DISCONNECT (J7)
REAR BUMPER DISCONNECTS
23
24
21
22/461
NEGATIVE LEAD BLACK
POSITIVE LEAD RED
TA027515

PIN	WIRE NO.	CIRCUIT
A	24	REAR B.O. MARKER (LH)
B	22-461	SERVICE STOPLIGHT (LH)
C	24	REAR B.O. MARKER (RH)
D	90	GROUND TO FRAME
E	489-21	SERVICE TAILLIGHT + CLEARANCE
F	23	B.O. STOPLIGHT
H	490	B.O. MARKER (CLEARANCE)
J	22-460	SERVICE STOPLIGHT (RH)
K	37B	AUXILIARY POWER
L	90	GROUND TO FRAME
M	53	NOT USED FOR LIGHTS
N	53B	NOT USED FOR LIGHTS

NOTE. REFER TO TRAILER MANUAL FOR TYPE AND LOCATION OF LIGHTS ON TRAILER

A. TRAILER RECEPTACLE VOLTAGE TEST

FRONT

PIN	WIRE NO.	CIRCUIT
A	17	HEADLIGHTS (HI BEAM)
B	18	HEADLIGHTS (LOW BEAM)
C	489	CLEARANCE LIGHTS
D	--	NOT USED
E	--	NOT USED
F	--	NOT USED

REAR

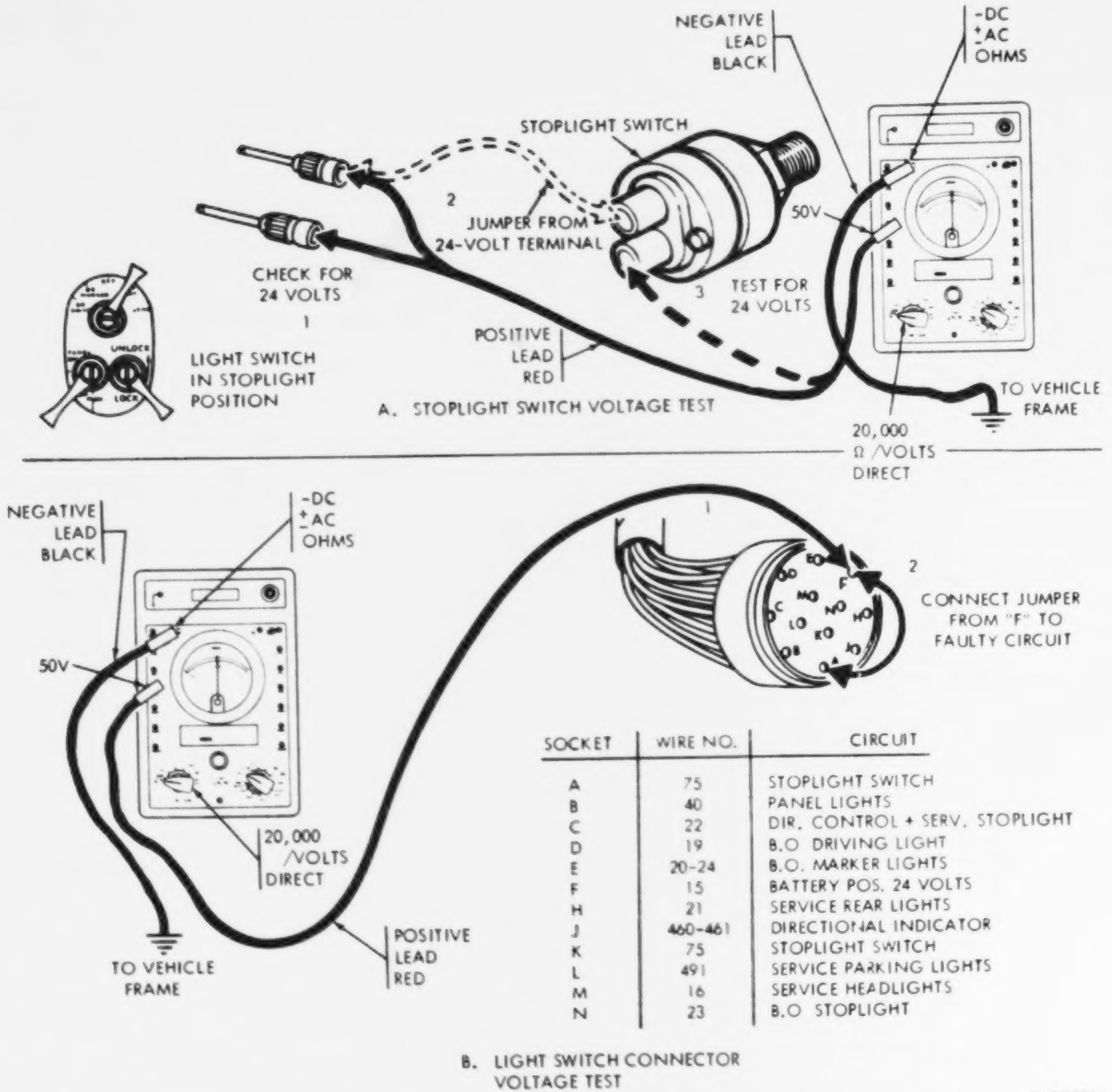
WIRE NO.	CIRCUIT
21	SERVICE TAILLIGHT
22/461	SERVICE STOPLIGHT
23	B/O STOPLIGHT
24	B/O TAILLIGHT

B. BUMPER/ CAB DISCONNECT VOLTAGE TEST

Figure 2-43. Trailer receptacle and bumper/cab disconnect voltage tests.

socket "F" of the connector, connect a jumper wire from "F" socket to socket of faulty circuit.

If lamps light with jumper wire connected, replace lighting switch. If some lamps do not light with jumper wire connected, check wiring harness from lighting switch to inoperative light or bumper/cab connector for broken wires. If malfunction cannot be determined, notify supporting maintenance to replace harness.


NEGATIVE LEAD BLACK
-DC
±AC
OHMS
STOPLIGHT SWITCH
2
JUMPER FROM 24-VOLT TERMINAL
50V
CHECK FOR 24 VOLTS
1
3
TEST FOR 24 VOLTS
LIGHT SWITCH IN STOPLIGHT POSITION
POSITIVE LEAD RED
TO VEHICLE FRAME
20,000 Ω /VOLTS DIRECT
NEGATIVE LEAD BLACK
-DC
±AC
OHMS
1
2
CONNECT JUMPER FROM "F" TO FAULTY CIRCUIT
50V
20,000 /VOLTS DIRECT
TO VEHICLE FRAME
POSITIVE LEAD RED
TA027516

A. STOPLIGHT SWITCH VOLTAGE TEST

SOCKET	WIRE NO.	CIRCUIT
A	75	STOPLIGHT SWITCH
B	40	PANEL LIGHTS
C	22	DIR. CONTROL + SERV. STOPLIGHT
D	19	B.O DRIVING LIGHT
E	20-24	B.O. MARKER LIGHTS
F	15	BATTERY POS. 24 VOLTS
H	21	SERVICE REAR LIGHTS
J	460-461	DIRECTIONAL INDICATOR
K	75	STOPLIGHT SWITCH
L	491	SERVICE PARKING LIGHTS
M	16	SERVICE HEADLIGHTS
N	23	B.O STOPLIGHT

B. LIGHT SWITCH CONNECTOR VOLTAGE TEST

Figure 2-44. Stoplight switch and connector voltage tests.

Table 2-27. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

DIRECTIONAL SIGNAL SYSTEM

DESCRIPTION: The directional signal system uses a solid-state (transistorized) flasher unit. The basic components consist of a directional signal control assembly, a flasher unit, connecting cables, and six lamps. These individual front lamps are amber colored, double-faced lamps and are visible to the front and rear. The rear lamps are combined with the service stoplights and are contained in two composite tail, stoplight, park and blackout marker light assemblies. Refer to and follow figure 2-40 wiring diagram. The system is energized by setting the light switch to STOPLIGHT or SERVICE DRIVE position, which supplies 24 volts to its terminal "J" to energize the coil of the B/O relay via wire 709. When the B/O relay is energized, its contacts close to supply 24 volts terminal "G" of the directional signal control unit. Moving the control unit lever to indicate a turn connects terminal "G" to terminal "F" and supplies 24 volts to the flasher unit. The flasher unit contains electronic circuitry which interrupts this 24 volts at a regular rate of ½ to 1-second intervals. This interrupted voltage appears at terminal "A" of the flasher unit and is returned to terminal "H" of the control unit via wire "A". An indicator lamp in the end of the control level is connected to terminal "A" and flashes on and off with the interrupted voltage. When the control lever is moved to indicate a left turn, the flasher unit is energized as described above. At the same time terminal "H" is connected to terminal "C" which connects to the left turn signal lamp via wire 22-461 and terminal "B" which connects to the left front turn signal lamps via wire 461. The stop-

Table 2-27. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

light switch circuit (terminal "D") is disconnected from the left stoplight circuit (terminal "C") and is connected only to the right stoplight circuit (terminal "E"), so the right stoplight will function normally when the service brakes are applied. When the control lever is moved to indicate a right turn, the same action occurs, except that terminal "E" is connected to the right rear stoplight via wire 22-460, and terminal "A" is connected to the right front turn signal lamp via wire 460. The stoplight switch circuit (terminal "D") is now disconnected from the right stoplight circuit (terminal "E") and connected only to the left stoplight circuit (terminal "C"), so the left stoplight will function normally when the service brakes are applied. When the control lever is moved to the hazard warning position, all four lights (terminals "A", "B", "C" and "E") are connected to terminal "H" so that all turn indicator lights on the vehicle (and trailer) will flash simultaneously. In this position, the stoplight switch (terminal "D") is disconnected completely, since the vehicle is normally not driven with the hazard warning lights in operation.

An overall test of the system is to perform all functions of the directional signal switch and observe the action of the lights as described above.

NOTE

Before starting tests, make a thorough visual inspection for loose connections, poor ground, or frayed cables. Make all necessary repairs before proceeding.

1. INDIVIDUAL LAMPS DO NOT LIGHT WITH DIRECTIONAL SIGNAL CONTROL LEVER IN ANY POSITION (CIRCUITS 460, 461, 22-460, 22-461).

Step 1. Perform lamp continuity test. Set main light switch to STOPLIGHT position. Try all positions of directional signal control lever, and observe which lights do not light in any position of the lever. Have assistant depress brake pedal and observe stoplights. If stoplights light, rear lamps are operational. If stoplights do not light, or if front turn indicators do not light in any position of the control lever, turn light switch to OFF and disconnect connector 460, 461, 22-460 or 22-461, corresponding to defective light (fig. 2-40). Set up multimeter for continuity test. Clip black test lead to vehicle frame. Touch red lead to connector on light, as shown in A, figure 2-45. If the meter-needle deflects to approximately 5 ohms, lamp is normal and trouble is elsewhere. If meter does not deflect at all (infinity reading) replace lamp (para 2-81) and retest. If meter still shows infinity or considerably more than 5 ohms, touch red test lead to frame ground, making sure to scrape through paint to bare metal.

If meter does not deflect completely to zero ohms, inspect ground wire, by removing wire and scraping all metal surfaces bright, when reconnecting. When light has been restored to 5 ohms, reconnect connector and test directional system again. If trouble still exists, perform wire harness tests.

Step 2. Perform wiring harness voltage test. Set up multimeter for dc voltage tests. Disconnect connectors 460, 461, 22-460 or 22-461, corresponding to defective light (fig. 2-45). Set main light switch to STOPLIGHT position, and directional signal control lever to HAZARD WARNING position. Connect multimeter as shown in B, figure 2-45. Clip black test lead to vehicle frame. Touch red test lead to center contact of cable connector on wiring harness. The voltmeter needle should deflect at a rate of 1 to 2 per second.

If meter does not deflect, leave connector disconnected from light and perform wiring harness continuity test.

Step 3. Perform wiring harness continuity test. Set up multimeter for continuity test. Set main light switch to OFF. Connect black test lead to vehicle frame near control unit. Remove cable connector from control unit. Touch red test lead to a socket in cable connector to correspond with defective circuit. The meter needle should not deflect (infinite reading). If there is any deflection, wiring harness has a short circuit or a high resistance leakage.

Inspect harness for frayed or pinched cables, and make repairs.

If infinity is indicated on meter, connect a jumper wire from vehicle frame to the cable connector at lights as shown in A, figure 2-46. Touch red test lead to appropriate socket terminal in cable connector at control unit. The meter needle should deflect fully showing zero ohms.

If less than full deflection, inspect the wiring harness for breaks, frayed wires, corroded connections, etc., and make necessary repairs or notify support personnel. When all lamps and wiring harness have continuity restored and system still does not operate, perform flasher and control unit tests.

2. NO LIGHTS OPERATE WITH DIRECTIONAL SIGNAL CONTROL LEVER IN ANY POSITION (CIRCUITS 460, 461, 467, 709).

Step 1. Perform directional signal control unit voltage feed test. Set up multimeter for dc voltage test. Remove cable connector from directional signal control unit. Set main light switch to STOPLIGHT position. Measure voltage from vehicle frame to terminal "G" of cable connector on wiring harness, as shown in B, figure 2-46. This meter needle should indicate 24 volts. If meter needle indicates 24 volts, B/O relay is operating normally. If meter indicates less than 24 volts, check at connection X1 circuit wire 709 of *B/O relay* (located behind front access door of vehicle cab), as shown in test P, figure 10. If meter indicates 24 volts, *B/O relay* is defective.

Replace B/O relay (para 2-78). If meter is less than 24 volts, but other lights function normally, light switch is defective. Replace light switch (para 2-74*d*). When 24 volts has been restored to contact "G" of directional control unit cable connector, and system still does not operate, perform flasher cable continuity test.

(CIRCUITS A, B, C)

Step 2. Flasher unit cable continuity test. Set up multimeter for continuity. Remove cable connector from flasher unit. Remove cable connector from control unit. Measure continuity between cable wires as shown in A, figure 2-47.

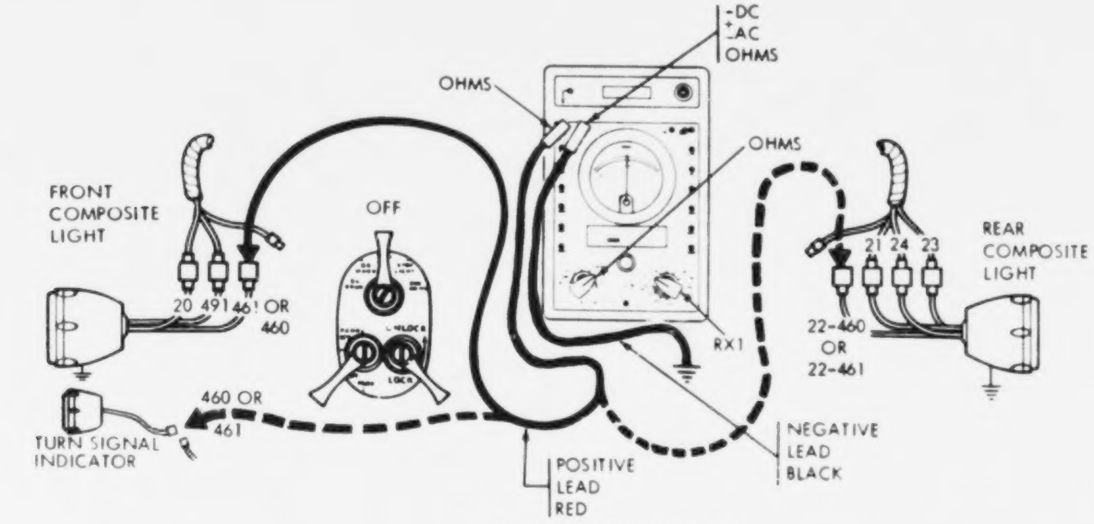
If any wire does not have continuity, inspect and make necessary repairs. If all three wires show continuity, perform flasher operational test.

NOTE

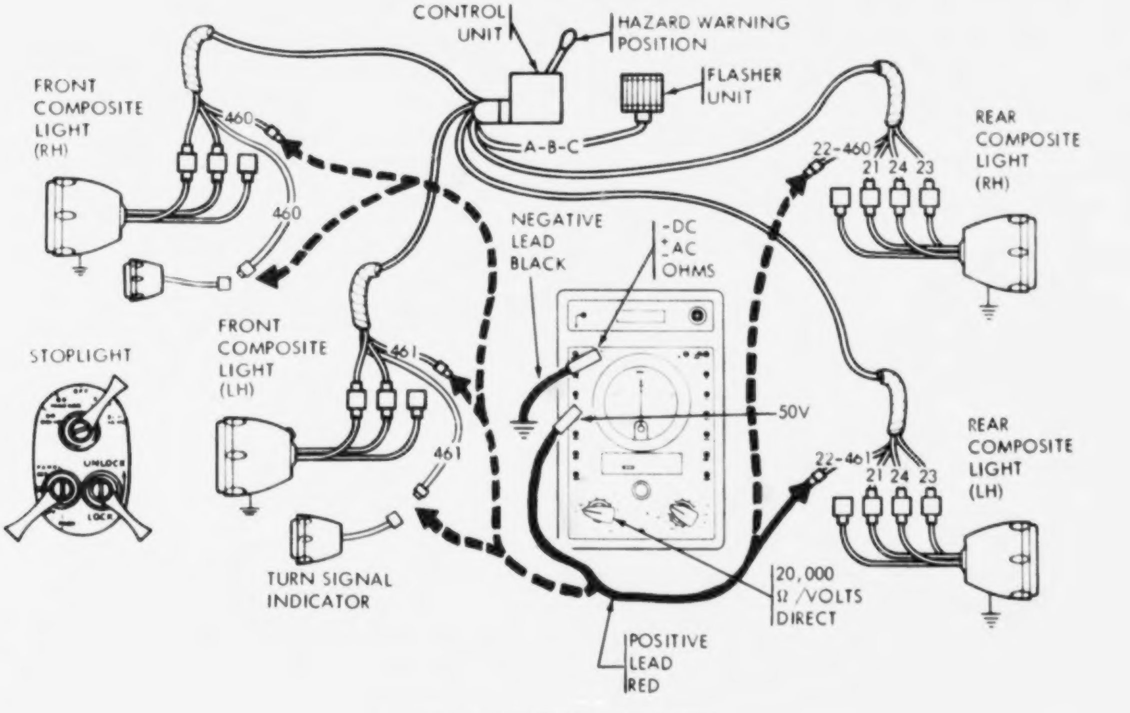
It may be necessary to remove flasher from vehicle to make following test: (refer to para 2-72).

Table 2-27. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


-DC
±AC
OHMS
OHMS
OHMS
FRONT COMPOSITE LIGHT
OFF
20 491 461 OR 460
RX1
21 24 23
REAR COMPOSITE LIGHT
22-460 OR 22-461
460 OR 461
TURN SIGNAL INDICATOR
POSITIVE LEAD RED
NEGATIVE LEAD BLACK

A. LAMP CONTINUITY TEST


CONTROL UNIT
HAZARD WARNING POSITION
FLASHER UNIT
FRONT COMPOSITE LIGHT (RH)
460
A-B-C
22-460
21 24 23
REAR COMPOSITE LIGHT (RH)
460
NEGATIVE LEAD BLACK
-DC
±AC
OHMS
STOPLIGHT
FRONT COMPOSITE LIGHT (LH)
461
461
50V
22-461
21 24 23
REAR COMPOSITE LIGHT (LH)
TURN SIGNAL INDICATOR
20,000 Ω /VOLTS DIRECT
POSITIVE LEAD RED

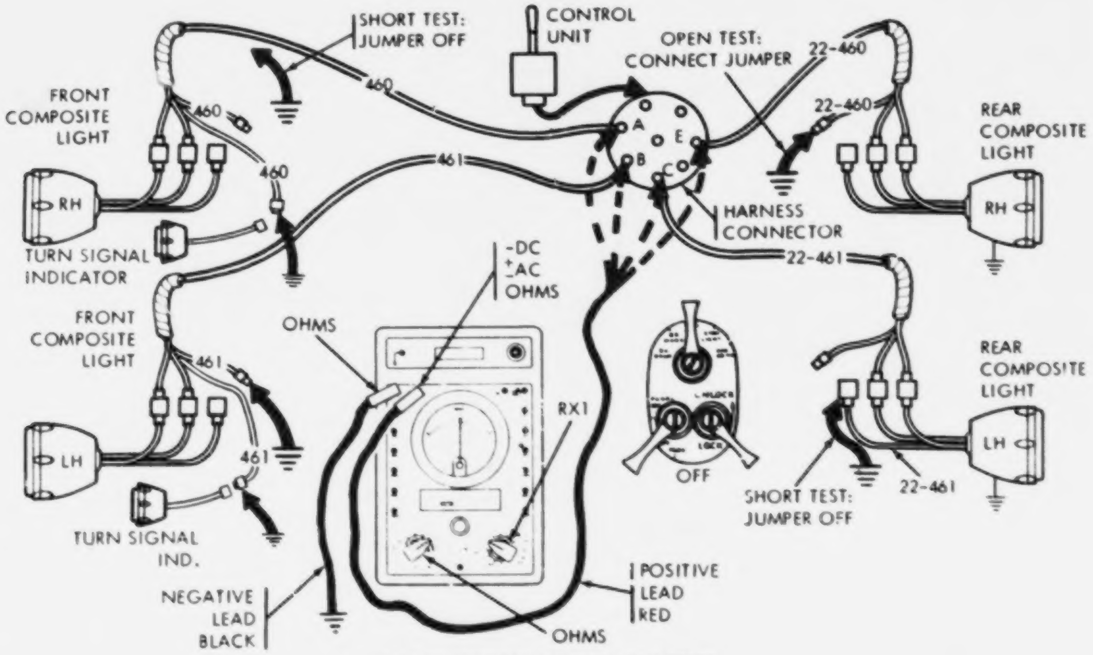
B. WIRING HARNESS VOLTAGE TESTS

TA027517

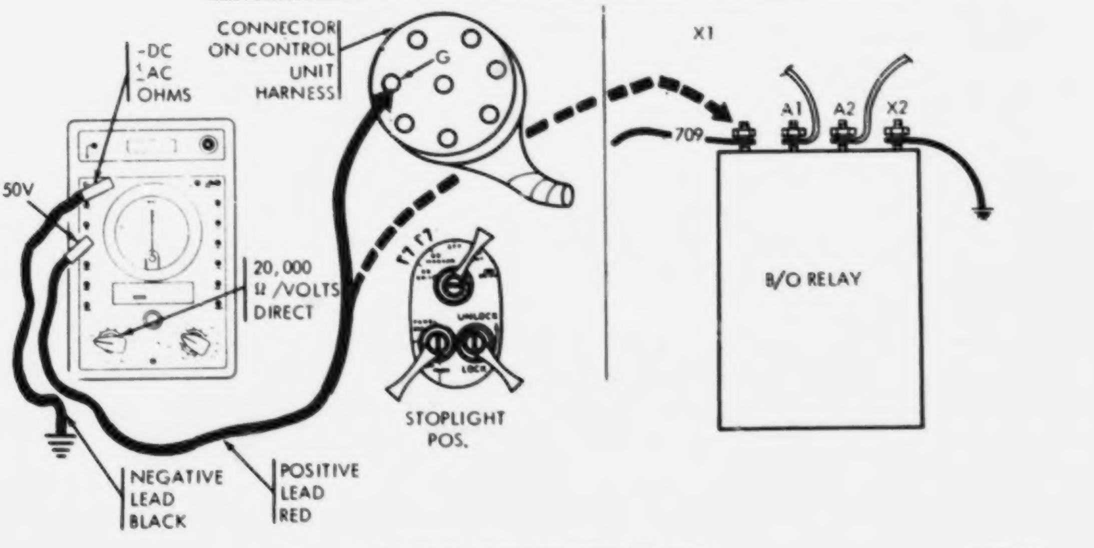
Figure 2-45. Turn signal lamp continuity test and wiring harness voltage tests.

Table 2-27. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


SHORT TEST:
JUMPER OFF
CONTROL
UNIT
OPEN TEST:
CONNECT JUMPER
22-460
22-460
FRONT
COMPOSITE
LIGHT
460
460
460
REAR
COMPOSITE
LIGHT
A
E
B
C
461
RH
RH
TURN SIGNAL
INDICATOR
HARNESS
CONNECTOR
22-461
-DC
+AC
OHMS
FRONT
COMPOSITE
LIGHT
OHMS
REAR
COMPOSITE
LIGHT
461
RX1
LH
461
LH
OFF
SHORT TEST:
JUMPER OFF
22-461
TURN SIGNAL
IND.
NEGATIVE
LEAD
BLACK
POSITIVE
LEAD
RED
OHMS

A. WIRING HARNESS CONTINUITY TESTS


CONNECTOR
ON CONTROL
UNIT
HARNESS
G
X1
-DC
+AC
OHMS
A1
A2
X2
709
50V
B/O RELAY
20,000
Ω /VOLTS
DIRECT
STOPLIGHT
POS.
NEGATIVE
LEAD
BLACK
POSITIVE
LEAD
RED

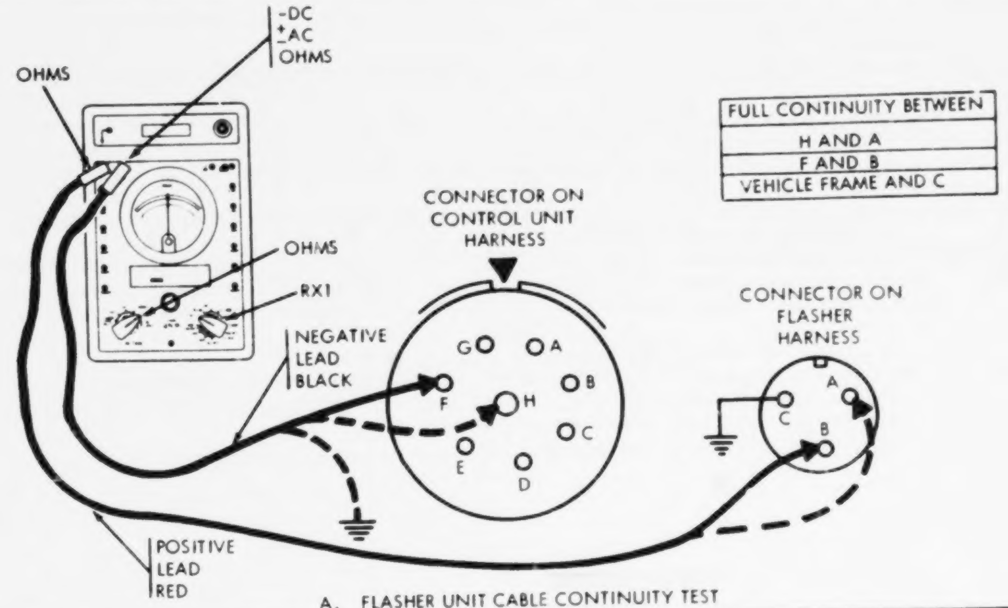
B. CONTROL UNIT VOLTAGE FEED TEST

TA027518

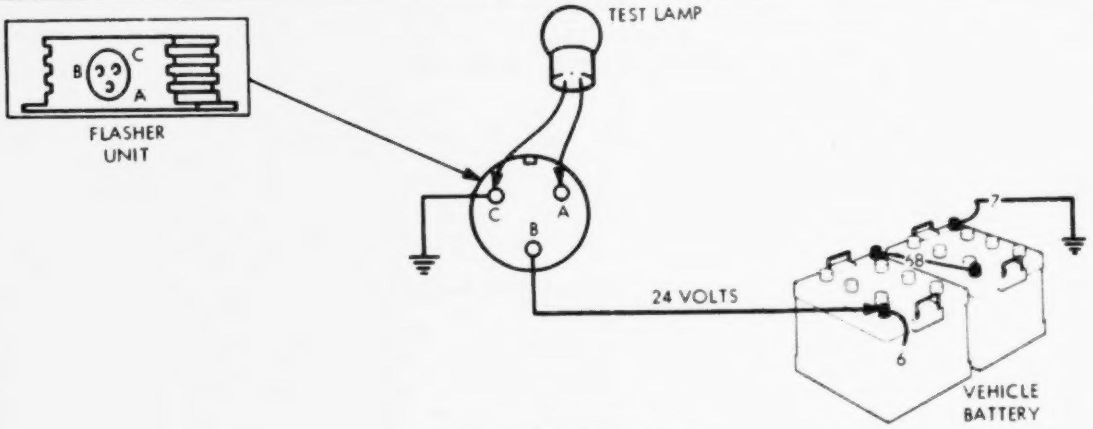
Figure 2-46. Wiring harness continuity and direction control unit voltage feed tests.

Table 2-27. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION


-DC
±AC
OHMS
OHMS
OHMS
RX1
NEGATIVE LEAD BLACK
POSITIVE LEAD RED
CONNECTOR ON CONTROL UNIT HARNESS
G
A
F
H
B
E
D
C
CONNECTOR ON FLASHER HARNESS
A
C
B
FULL CONTINUITY BETWEEN
H AND A
F AND B
VEHICLE FRAME AND C

A. FLASHER UNIT CABLE CONTINUITY TEST


TEST LAMP
B
C
A
FLASHER UNIT
C
A
B
24 VOLTS
7
8
6
VEHICLE BATTERY

B. FLASHER OPERATIONAL TEST

TA027519

Figure 2-47. Flasher operational and cable continuity tests.

3. FLASHES ERRATICALLY, NO FLASH, OR VERY SLOW FLASH (CIRCUITS A, B, C).

Step 1. Perform flasher operational test. Disconnect cable connectors from flasher. Connect a source of positive 24 volts to terminal "B" of flasher socket. (If voltage is inadvertently reversed to flasher, it will not operate. However, flasher will not be harmed, due to built-in reversal protection.) Connect one lamp type MS-35478-1683 between contact "A" and "C". Connect contact "C" to negative 24 volts, as shown in B, figure 2-47. The flasher should flash at a rate of 60 to 130 flashes per minute, at a regular rate without skipping.

If it does not flash, or flashes irregularly, replace flasher unit (para 2-72). If flasher tests satisfactorily, perform control unit bench test.

NOTE

It may be necessary to remove directional signal control unit from vehicle to perform the following test.

4. SYSTEM OPERATES INCORRECTLY IN ONE OR MORE POSITIONS OF THE DIRECTIONAL SIGNAL CONTROL LEVER (ALL LIGHTS AND WIRING HARNESS TEST SATISFACTORY) (CIRCUITS 22-460, 22-461, 22, 467, 461, 460, A, B).

Step 1. Perform directional signal control unit continuity test. Set up multimeter for continuity tests. Remove cable connector from control unit, and if necessary, remove control unit from vehicle. Remove indicator lamp from control unit (para 2-81). Set control lever in each of four operating positions and make tests as shown in figure 2-48.

If any circuit does not test as shown in tables, replace control unit (para 2-81).

Table 2-27. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. ALL ILLUMINATION LAMPS DO NOT LIGHT (CIRCUITS 40, 40A, 40B).

Perform malfunction 9.

6. PANEL LIGHTS OR GEAR SELECTOR DOES NOT ILLUMINATE (OTHER ILLUMINATION LIGHTS ARE OPERATIVE) (CIRCUIT 40).

Assure bulb is operative. Replace with new bulb if necessary (para 2-74*c*). Place light switch in STOPLIGHT position and place panel light switch in BRT. Disconnect connector from malfunction lamp. Set up multimeter for voltage test. Connect black lead to ground and red lead to harness connector taken off from lamp assembly. If 24 volts exist, replace defective lamp socket assembly. If 24 volts does not exist, harness between light switch and lamp is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

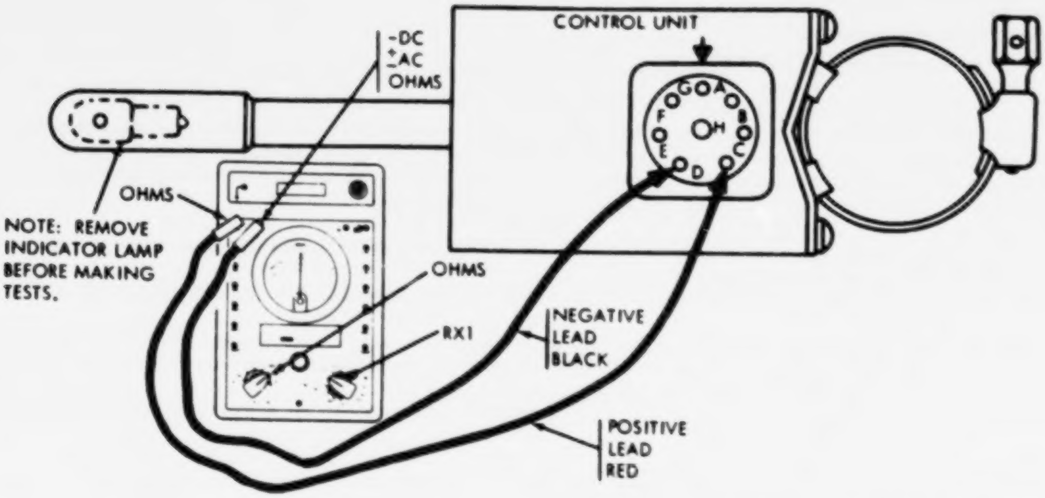
7. AIR PRESSURE GAGE ILLUMINATION LIGHT NOT OPERATIVE, ALL OTHER PANEL LIGHTS OPERATIVE (CIRCUIT 40A).

Step 1. Assure bulb is operative. Replace with new bulb if necessary. Place light switch in STOPLIGHT position and panel light switch in BRT. Disconnect J4 at panel. Check harness connector for 24 volts. Set multimeter for voltage. Connect black lead to ground and red lead to J4A.

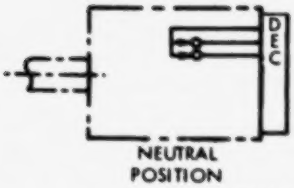
If 24 volts is not present, replace harness from J4 to light switch (para 2-79).

Step 2. If 24 volts is present, reconnect J4 and connect red lead to lamp terminal. (Black lead still connected to ground.)

If 24 volts is present, replace lamp socket assembly. If 24 volts is not present, wire between lamp and J4 is defective. Inspect connector for bent or dirty contacts. Repair or replace wire (para 2-79).

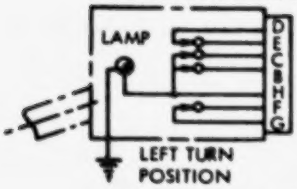

CONTROL UNIT
-DC
±AC
OHMS
OHMS
NOTE: REMOVE INDICATOR LAMP BEFORE MAKING TESTS.
OHMS
RX1
NEGATIVE LEAD BLACK
POSITIVE LEAD RED
G
A
B
C
D
E
F
H

SCHEMATIC DIAGRAM


D
E
C
NEUTRAL POSITION

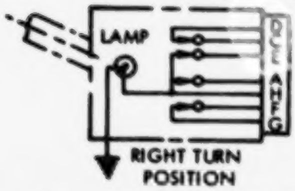
FROM PIN:	TO PIN:	INDICATION
H	A	OPEN
H	B	OPEN
H	C	OPEN
H	E	OPEN
D	C	SHORTED
D	E	SHORTED
F	G	OPEN

A. DIRECTIONAL SIGNAL CONTROL LEVER IN "NEUTRAL" POSITION


LAMP
D
E
C
B
H
F
G
LEFT TURN POSITION

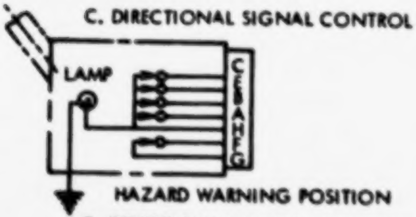
FROM PIN:	TO PIN:	INDICATION
H	B	SHORTED
H	C	SHORTED
H	A	OPEN
H	E	OPEN
F	G	SHORTED
D	E	SHORTED
D	C	OPEN

B. DIRECTIONAL SIGNAL CONTROL LEVER IN "LEFT TURN" POSITION


LAMP
D
C
E
A
H
F
G
RIGHT TURN POSITION

FROM PIN:	TO PIN:	INDICATION
F	G	SHORTED
H	A	SHORTED
H	E	SHORTED
H	B	OPEN
H	C	OPEN
D	C	SHORTED
D	E	OPEN

C. DIRECTIONAL SIGNAL CONTROL LEVER IN "RIGHT TURN" POSITION


LAMP
C
E
B
A
H
F
G
HAZARD WARNING POSITION

FROM PIN:	TO PIN:	INDICATION
H	A	SHORTED
H	B	SHORTED
H	C	SHORTED
H	E	SHORTED
D	E	OPEN
D	C	OPEN
F	G	SHORTED

D. DIRECTIONAL SIGNAL CONTROL LEVER IN "HAZARD WARNING" POSITION

TA027520

Figure 2-48. Directional signal control unit continuity tests.

FLOOD LIGHTS AND UTILITY OUTLET SYSTEM

DESCRIPTION: The removable flood lights are connected to the vehicle lighting system through a coil cord wiring harness from the lamp assembly to the connector at the fenders. A control switch and power is supplied to the switch through the vehicle circuits when the light switch in the cab is in the STOPLIGHT or SERVICE position. A 24 volt supply at the utility outlet is protected by circuit breaker 8. Both of the systems described above are connected through the B/O relay. During B/O conditions, the lamps and outlet are inoperative.

NOTE

Before troubleshooting the lighting system, refer to the TM 9-2320-258-10 to become familiar with the lighting arrangement for each switch position and the nomenclature for each light.

1. GENERALLY UNSATISFACTORY LIGHTING (FLICKERING, DIM, FREQUENT BURNOUTS, INTERMITTENT) (CIRCUITS 15, 709, 39, 518, 518A, 518B).

Perform a visual inspection. Inspect connections at light switch and each individual light. Inspect coil cords for frayed, broken or damaged wires. If complaint is short lamp life, or frequent burnout of lamps, check for high generating system voltage (table 2-29) or loose lamp housings or operating components that would cause excessive vibration.

Before discarding a lamp that has been removed, test it in another light socket, or with an ohmmeter, to determine whether lamp or socket is at fault.

NOTE

The following voltage tests may be performed with either multimeter, or voltmeter section of low voltage circuit tester.

2. FLOOD LIGHTS (BOTH SIDES) AND THE UTILITY OUTLET INOPERATIVE.

Step 1. Black out relay function check. Turn light switch to SERVICE position. Turn on warning beacon light and/or turn signal flashers. If beacon and/or flasher operate, blackout relay is functioning properly. Proceed to step 2.

If neither function, perform blackout relay test table 2-27, malfunction 2, step 1.

Step 2. Disconnect wire #657 from C.B. 8. Connect red lead of multimeter to wire 657, black lead to ground. If 24 volts exist, reconnect and proceed to step 3. If not, harness between C.B. 8 and B/O relay is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Disconnect opposite wire on C.B. 8 with red lead connected to circuit breaker terminal, and black lead to ground. Check for 24 volts. If 24 volts does not exist, replace defective C.B. 8. If 24 volts does exist, harness between C.B. 8 and J12 and J13 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

3. UTILITY OUTLET INOPERATIVE (CIRCUIT 37A).

Assure either right or left work light is operative. See TM 9-2320-258-10 for correct switch position. If neither light is operative, perform malfunction 2, step 1. If either light is operative, proceed to step 1 below.

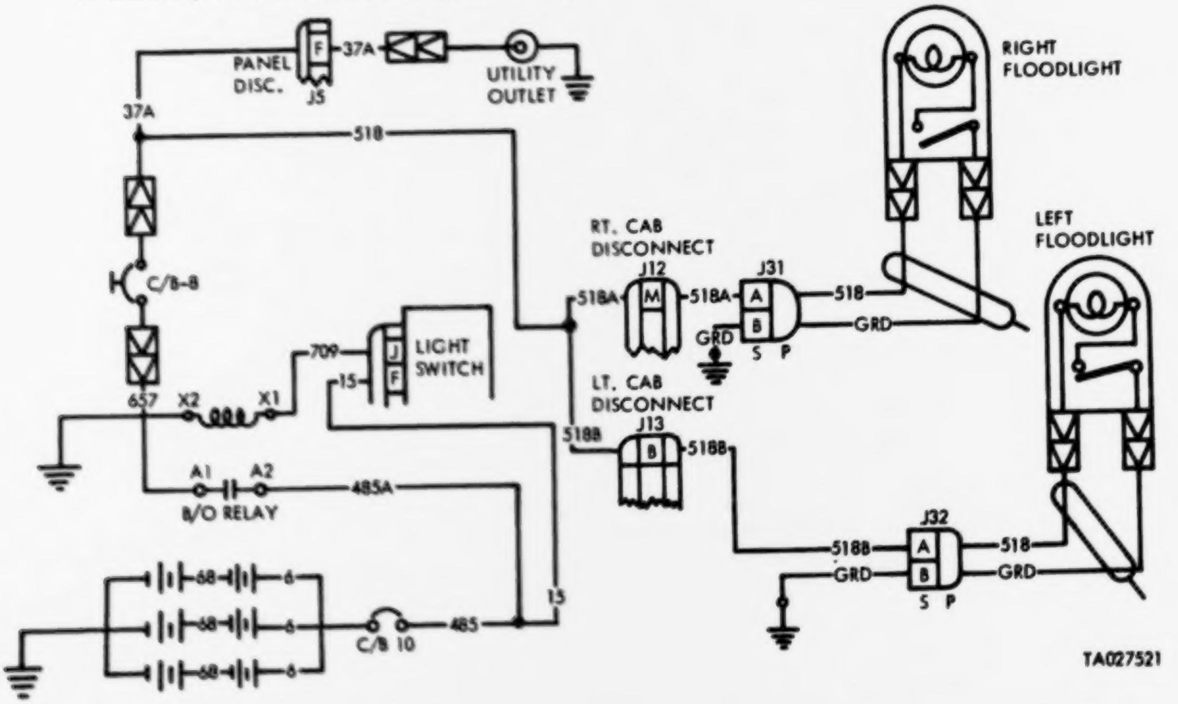


Figure 2-49. Flood lights and utility outlet electrical schematic.

Table 2-28. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 1. Connect red lead to multimeter to plus (+) terminal of utility outlet. Connect black lead to minus (-) terminal. Set meter for 50 vdc and check for 24 volts. If 24 volts is present, outlet is functional. Check accessory for malfunction. If 24 volts is not present, proceed to step 2 below.

Step 2. Disconnect lead coming from utility outlet. With multimeter set for 50 vdc, connect red to wire 37A (harness connector) and black lead to ground.

If 24 volts is present, replace defective utility outlet (para 2-65). If 24 volts is not present, proceed to step 3 below.

Step 3. Disconnect connector J5. Connect red lead to J5F (on harness connector from circuit breaker 8), and black lead to ground. Check for 24 volts. If 24 volts is present, harness between J5 and utility outlet is defective (para 2-79). If 24 volts is not present, harness between J5 and C.B. 8 is defective.

Inspect connector for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

4. ONE WORK LIGHT IS INOPERATIVE.

Before starting test, assure lamp is in operating condition. If condition of lamp cannot be determined, replace with a new one (para 2-70). If still inoperative, proceed to step 1.

Step 1. Turn starter switch in ON position. Turn light switch in SERVICE position. Disconnect leads at defective light. Set multimeter for 50 vdc and check for 24 volts. Place red lead to wire 518, and black lead to GRD wire. If 24 volts exist, replace defective work lamp (para 2-70). If 24 volts does not exist, proceed to step 2.

Step 2. Disconnect J31 (connector J32 if left work light is defective) and check for 24 volts. Connect red lead of multimeter to contact A and black lead to contact B (on connector coming from cab). If 24 volts is not present, proceed to step 3. If 24 volts is present, harness between connector tested and work light is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs (para 2-70).

Step 3. Disconnect J12 (J13 if left flood light is inoperative) at cab disconnects. Check for 24 volts from connector coming from panel. If right light is defective, connect red lead to J12M. If left is defective, connect red lead to J13B. Connect black lead to ground in both cases. If 24 volts is not present, harness between connector tested and C.B. 8 is defective. If 24 volts is present, harness between connector (J12 or J13) and connector J31 (J32 if left light is defective) is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Table 2-29. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ALTERNATOR CHARGING SYSTEM

DESCRIPTION: The charging system for the M746 tractor consists of a 100 ampere, 28 volt negative ground alternator with internal rectification and external voltage regulation. The alternator, with its internal rectifiers, is belt driven by the left front camshaft pulley. Battery reference voltage is provided to the charging system through pin F of the regulator connector (fig. 2-50). This voltage is supplied through two parallel circuits connecting pin F to the batteries. The first is from the disconnect side of the master relay contacts for normal operation when the starter switch is ON. The second circuit is connected directly to the batteries through a normally open, 6 psi, oil pressure switch. When the engine is running, the pressure switch is closed by engine oil pressure to complete the circuit to pin F. This circuit is provided as a safety feature to the charging system in the event that master switch is turned off while the engine is running. If the reference voltage is lost while the engine is running, the alternator can be damaged by trying to reach too high a voltage. When the engine is stopped, the pressure switch opens, due to the loss of lube pressure, to disconnect pin F from the batteries to prevent battery current drain when the vehicle is not being operated. The alternator field is, therefore, energized by the battery voltage supplied to pin F of the regulator, through circuits 2, 2A and 2B, where the field voltage applied to the alternator is varied to maintain the system voltage at 28 ± .5 volts. The mechanical rotation of the alternator armature generates 3-phase alternating current (AC) which is changed (recitified) into direct current (DC), by the diodes mounted inside of the alternator assembly. The 28 volts put out by the system is used to charge the batteries, and to assist the batteries in carrying the load of the tractor and trailer.

TEST PRECAUTIONS:

1. The alternator is relatively new and unfamiliar in military vehicles. It is very important that the following precautions are observed to prevent damage to the alternator and regulator.
2. NEVER reverse the battery connections. ALWAYS check the battery connecting cables with a voltmeter before any attachments are made to be sure that the negative cable will be connected to the alternator frame and the positive cable to the alternator positive terminal. Reversal will immediately burn out the rectifiers, which cannot stand the reverse polarity.
3. Booster batteries for cold weather starting must be properly connected. Make sure that the negative cable of the booster battery connects to the negative terminal of the vehicle battery and the positive cable to the positive terminal. If in doubt, use a voltmeter to check - NEVER make a trial connection by "flashing" the cable.
4. ALWAYS disconnect the battery cables before connecting a fast charger to the battery.
5. NEVER use a fast charger for starting the engine. Use another battery or a booster made for the express purpose of starting engines.
6. NEVER disconnect the voltage regulator sensing lead (Circuit 2) while the engine is running. This is the only information the regulator has on the battery voltage. If the lead is removed, the alternator will burn itself out trying to reach 28 volts.
7. NEVER ground the alternator output terminal. The internal resistance is very low and an external short circuit will overload all the regulating and generating circuits, resulting in burnout.

Table 2-29. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

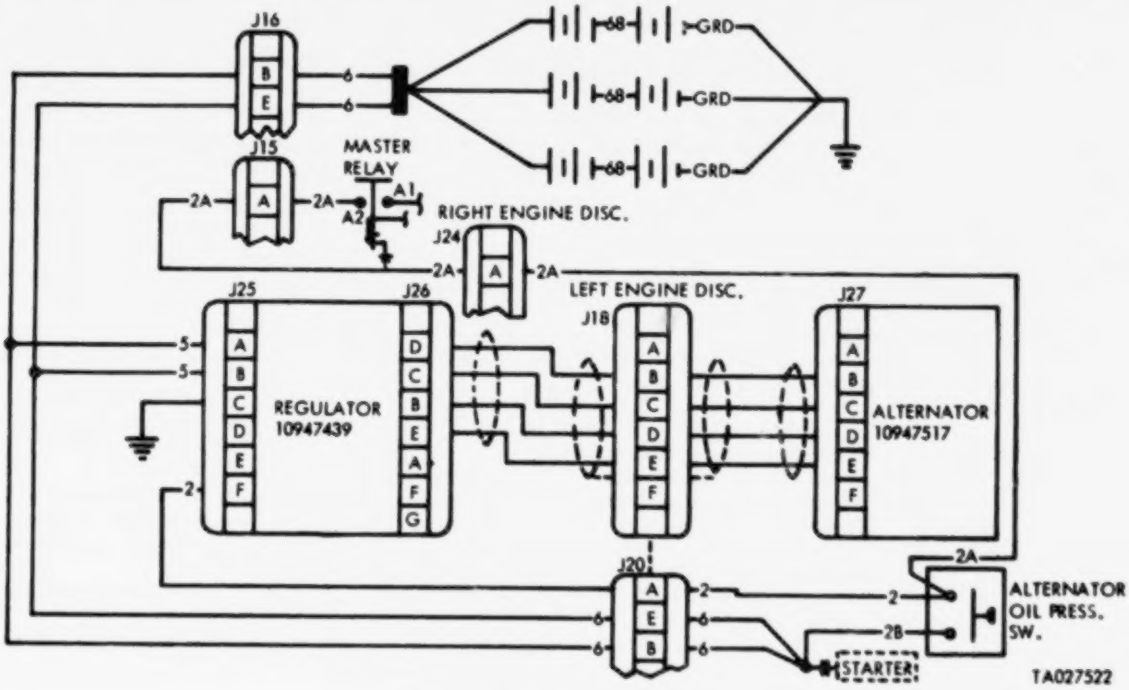


Figure 2-50. Charging system schematic.

8. NEVER operate the alternator with the master switch off.
9. NEVER try to polarize an alternator. It is not necessary and could result in expensive damage.
10. NEVER disconnect batteries with engine running.

PRELIMINARY PROCEDURES:

Start and run engine at fast idle until normal operating temperatures are reached. Make a visual inspection. Check belt tension (para 2-56*c*) bearings, loose terminals on alternator, batteries and starter switch. Also looked for frayed or broken wires, corrosion or any other visible signs of damage, deterioration, or maladjustment. Assure batteries are fully charged (table 2-13). Make any required repairs or charging before proceeding with further test. If batteries are overcharged, turn on external loads, (lights, work lamp, beacon) until battery voltage drops to 24-25 volts.

1. FAILURE OF THE ALTERNATOR USUALLY RESULTS IN DISCHARGED OR OVERCHARGED BATTERIES. IF THE BATTERIES BECOME DISCHARGED WITHOUT OBVIOUS CAUSE, THE ALTERNATOR MAY BE AT FAULT. QUITE OFTEN FAILURE OF THE ALTERNATOR MAY BE ANTICIPATED BY OBSERVING THE BATTERY-GENERATOR INDICATOR (CIRCUITS 2, 2A, 28, 56).

Step 1. Turn starter switch OFF. Set multimeter to test voltage on 50 vdc. Connect red lead to positive socket of slave receptacle and black one to negative receptacle. A voltage of 24 to 25 volts should be present. If not, refer to table 2 and check the battery cables. If 24-25 volts is present, check battery/generator gage on panel. If needle is not in top section of yellow area, see table 4 (troubleshooting gages). If gage is in range, start engine and turn on headlights, work lamps and rotating beacon. A voltage of 27.5-28.5 volts should be present on meter. If voltage is not in range, proceed to step 2. If voltage is in range, check battery/generator gage. If needle is not in middle portion of green section, see table 4 (troubleshooting the gages). If both of voltages (with and without engine running) are in range and batteries tend to undercharge or overcharge over a period of time, turn off engine and all systems and proceed to step 2.

Step 2. Disconnect J26 from voltage regulator. Turn starter switch to ON position. Set up multimeter to test voltage on 50 vdc. Connect meter leads as indicated in Chart 8 and check for specified voltages (Connect leads to connector on regulator.)

Red lead	*Black lead*	*Voltage*
J26C	J26D	24 ± 1V
J26B	J26D	24 ± 1V
J26B	J26C	0V

Chart 8

Table 2-29. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

If all voltages are present, turn starter switch OFF and proceed to step 3. If voltages are not present, disconnect J25 from regulator. Set multimeter to check for continuity on RX1 scale. Connect black lead to ground and red lead to harness connector J25C. If continuity does not exist, replace ground wire from J25 to ground. If continuity exists, remove leads and set up multimeter for voltage test on 50 vdc. Connect meter leads on harness connector and check for specified voltages as in Chart 9 when starter switch is ON.

Red lead	Black lead	Voltage
J25A	J25C	24 ± 1V
J25B	J25C	24 ± 1V
J25F	J25C	24 ± 1V

Chart 9

If all voltages are present, replace defective voltage regulator (para 2-58). If voltage is not present on contact F, proceed to malfunction 2, step 2. If voltages are not present on contacts A and B, check connectors J25, J16 and battery contacts for bent or dirty contacts.

Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Step 3. Set up multimeter for continuity test on RX1 scale. Connect leads to harness connector J26 and check for specified resistance in Chart 10.

Red lead	Black lead	Resistance
J26D	J26C	Low (Less than 15Ω)
J26C	J26D	High (Infinity)
J26B	J26E	Low (2-10Ω)

Chart 10

If all resistances are present, reconnect all connectors and proceed to step 5. If any of the resistances are not present, proceed to step 4.

Step 4. Disconnect J27 at alternator. Set up multimeter for continuity test on the RX1 scale. Connect leads to alternator connector and check for specified resistance reading (Chart 11).

Red lead	Black lead	Resistance
J27B	J27C	Low (Below 15Ω)
J27C	J27B	High (Infinite)
J27D	J27E	Low (7-10Ω)
J27B	Alternator Housing	High (Infinite)
J27D	Alternator Housing	High (Infinite)

Chart 11

If any resistance is not present, replace defective alternator (para 2-56). If all resistances are present, reconnect J27 and disconnect J18 at right engine disconnect. Connect meter leads to connector on engine and check for specified resistances as shown in Chart 12.

Red lead	Black lead	Resistance
J18B	J18C	Low (Below 15Ω)
J18C	J18B	High (Infinite)
J18D	J18E	Low (2-10Ω)
J18B	Ground	High (Infinite)
J18C	Ground	High (Infinite)
J18E	Ground	High (Infinite)
J18D	Ground	High (Infinite)

Chart 12

If any resistance is not present, harness between J18 and J27 is defective. If all resistances are present, harness between J18 and J26 is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-29. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

2. REGULATOR ADJUSTMENT.

Step 1. Assure batteries are fully charged. Turn on service headlights and run engine for 10 to 15 minutes to bring regulator to operating temperatures. With engine running, connect a multimeter (set for 50 vdc), across battery terminals. Connect red lead to positive (+) terminal and black lead to negative (-) terminal. Remove screw plug from top of regulator. Insert small screwdriver in plug opening and turn screw until voltage across batteries reads 28 volts. (Turn screw clockwise to decrease voltage, and counterclockwise to increase voltages.

If voltage cannot be adjusted, or if problem of over or undercharge still exists over a perid of time, turn engine OFF and proceed to step 4. Replace voltage regulator (para 2-58). Perform voltage regulation adjustment of new regulator (step 1 above). If new regulator cannot be adjusted, replace alternator (para 2-56).

Step 2. Disconnect J20 from left engine disconnect. Assure starter switch is ON. Connect red lead of multimeter to J20A, (cowl connector) and black lead to ground. If 24-28 volts are present, harness between J25 and J20 is defective. If voltage is not present, disconnect red meter lead and connect it to alternator oil pressure switch terminal which wires 2 and 2A are connected. If 24-26 volts are present, harness between J20 and alternator oil pressure switch is defective. If voltage is not present, disconnect J24 from right engine disconnect. Connect red lead of multimeter to harness connector J24A and black lead to ground. If 24-26 volts are present, harness between J24 and alternator oil pressure switch is defectve. If voltage is not present, disconnect J15 at the cab. Disconnect, connect red lead of multimeter to J15A (connector coming from panel) and black lead to ground. If 24-26 volts is present, harness between J15 and J24 is defective. If voltage is not present, harness between J15 and master relay (terminal A2) is defective.

Inspect connector for bent or dirty pins. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance to replace harness.

Table 2-30. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

BATTERY HEAT SYSTEM

DESCRIPTION: The battery compartment receives warm air from the personnel heater any time the heater is on and the battery temperature is below 40° F. The system consists of three main components; the battery heat relay, battery heat solenoid and the battery thermostat (fig. 2-51). The battery heat relay is energized from the heater control via circuit 479, when the heater is turned on. This signal closes the relay and the battery heat solenoid is energized through circuit 479A. The solenoid is a rotary type which opens and closes a door in the duct work of the personnel heater. When the solenoid is energized (door open), 10% of the heater warm air is diverted into the battery box to warm the batteries. Two of the circuits (479C and 479B) come from the battery heat relay, and the third is a ground circuit. As the electrolyte temperature in the battery rises above 40° F, circuit 479B is completed to

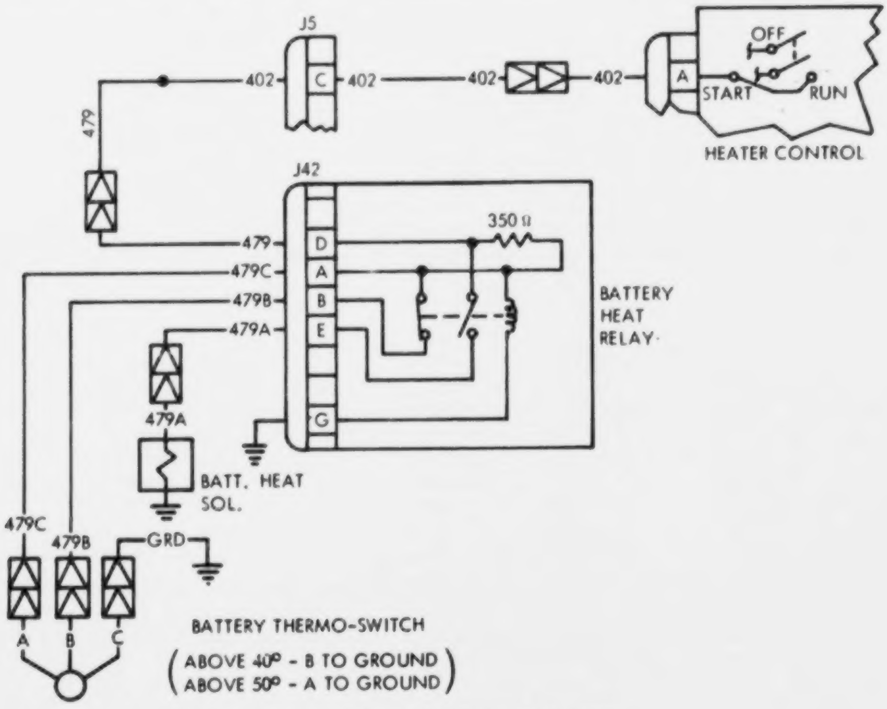


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Figure 2-51. Battery heat system.

Table 2-30. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ground. As the temperature rises above 50° F, circuit 479C is completed to ground. With both circuits grounded, the relay is shorted and the solenoid (door) closes allowing no warm air to flow into the battery box. As the temperature falls below 40° F, both circuits are now open and the relay is energized again. The relay then completes a path for the solenoid to energize and open the door (allowing warm air to enter the battery box). The batteries will maintain a temperature between 40° F and 50° F in cold weather, as long as the personnel heater is being used. When the personnel heater is turned off, the solenoid (door) is closed which prevents any fumes in the battery compartment from entering the cab.

1. BATTERY COMPARTMENT WILL NOT HEAT OR WILL OVERHEAT WHEN PERSONNEL HEATER IS OPERATING (BATTERY HEAT SOLENOID NOT FUNCTIONING CORRECTLY) (CIRCUITS 402, 479).

Step 1. Assure heater and heater fuel pump is operative. If not, see troubleshooting table 8. Disconnect J5 from panel. Turn heater switch to RUN position. Set multimeter for 50 vdc. Connect red lead to J5C (panel connector) and black lead to ground. If 24 volts does not exist, harness between J5 and heater control is defective. If 24 volts exist, disconnect wire 402 from heater fuel pump and reconnect J5. Disconnect J42 at battery heat relay. Connect red lead to harness connector J42D and black lead to ground. If 24 volts exist, proceed to step 2. If 24 volts does not exist, harness between J5 and J42 is defective.

(CIRCUITS 479, 479A, 479B, 479C)

Step 2. Set up multimeter to check resistance. Connect meter leads as in Chart 13 and check for specified resistances. (Connect to relay connector.)

Red lead	Black lead	Resistance
J42D	J42A	300-400 Ω
J42D	J42G	600-800 Ω
J42D	J42E	Infinite (High)
J42A	J42B	Less than 1 ohm (on RX1 scale)
J42A	J42G	300-400 Ω

Chart 13

If all the resistances are present, proceed with test. If any of the resistances are not present, replace battery heat relay (para 2-67*e*). Disconnect wires 479C, 479B, and GRD wire from battery thermostat, and wire 479A from battery head solenoid. Check for continuity on RX1 scale. Connect leads to harness connector J42 and harness connectors from battery thermostat and solenoid (Chart 14).

Red lead	Black lead	Resistance
J42E	479A	Continuity
J42A	479C	Continuity
J42B	479B	Continuity
GRD Connector	Ground	Continuity
J42G	Ground	Continuity
J42A	J42B	No Continuity Infinite Resistance
J42B	J42E	No Continuity Infinite Resistance

Chart 14

If all of the resistances are present, proceed to step 3. If any of the resistances are not present, harness between J42 and thermostat/solenoid is defective.

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident or cannot be determined, notify supporting maintenance.

(CIRCUIT 479A)

Step 3. Turn heater switch to OFF position. Reconnect J42 and wire 479A. The solenoid (door) should be in a CLOSED position (allowing no air to enter battery box). If door is in an OPEN position, replace solenoid (para 2-67*f*). Turn heater switch to RUN position. The door should now change position to allow air to flow into battery box. If door does open, proceed to step 4. If solenoid (door) does not change position, disconnect 479A from solenoid. Set multimeter to check voltage on 50 vdc. Connect red line to wire 479A and black lead to ground. If 24 volts exist, replace defective solenoid. If 24 volts does not exist, replace battery heat relay (para 2-67*e*).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Step 4. Connect a jumper wire from harness connector on wire 479B to ground. Solenoid door should remain in OPEN position allowing air to enter battery box. If solenoid CLOSES, replace battery heat relay (para 2-67*e*). Connect another jumper from harness connector on wire 479C to ground. Solenoid door should now CLOSE allowing no air to battery box. If not, replace battery heat relay (para 2-67*e*). Disconnect second jumper connected (from 479C to ground). The solenoid should remain in CLOSED position. If not, replace battery heat relay (para 2-67*e*). Disconnect first jumper connected (from 479B to ground). The solenoid door should change to an OPEN position. If not, replace battery heat relay (para 2-67*e*). If door does OPEN and CLOSE as specified in

Table 2-30. Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

tests, and problem is overheating or underheating, replace battery thermostat (para 2-67c).

Inspect connectors for bent or dirty contacts. Make necessary repairs. If any other malfunction is evident, or cannot be determined, notify supporting maintenance.

Section VII. RADIO FREQUENCY INTERFERENCE SUPPRESSION

2-26. Purpose

a. Radio frequency interference (RFI) suppression is the elimination or minimizing of electrical disturbances in the radio frequency range. This RFI is generated by the engine and vehicle accessories and may interfere with radio reception or disclose the vehicle location to sensitive electrical detectors. It is important that electrical disturbances in vehicles with radios, as well as vehicles without, be suppressed properly to prevent interference with reception of neighboring vehicles.

b. Suppression in the M746 truck tractor is accomplished by use of radio frequency filters and capacitors (condensers). In addition, metal parts in the vicinity of the engine are formed into a shield by use of ground cables and tooth-type (star) lockwashers, confining electrical disturbances so they cannot disturb receiving equipment. Wiring that may carry interfering surges to a point where interferences will affect radio reception are also shielded.

2-27. Interference Supression Components

a. Primary Suppression Components. The primary suppression components are those whose primary function is to suppress RFI such as frequency filters, capacitors, and shielded wiring.

b. Secondary Suppression Components. These components have RFI suppression functions which are incidental and/or secondary to their primary functions such as ground cables and star lockwashers.

2-28. Description

The systems listed below have been treated to accomplish suppression of RFI.

NOTE

Since diesel engines do not use electrical ignition, spark discharge interference does not exist in this vehicle.

a. Generating (Charging) System. Radio frequency filters have been included in the construction of the generator, regulator, and rectifier, and the connecting cables have been shielded.

b. Starting System. The starting system components are shielded and grounded to eliminate rotary brush interference.

c. Accessory and Auxiliary Equipment. All accessory and auxiliary equipment is constructed to specifications requiring suppression of RFI.

2-29. Fasteners and Ground Cables

Ground cables are used where necessary to unite critical parts thereby forming a solid electrical circuit to conduct RFI currents directly to the vehicle ground and away from antennas. Tooth-type lockwashers are installed at all ground cables and critical electrical component ground connections. It is important that all bond straps be in good condition, that all tooth-type lockwashers be installed, and that all retaining screws and nuts be tightened to form a ground connection. Scrape all contacting metal surfaces clean before tightening ground cables.

2-30. Test for RFI Suppression

The overall efficiency of the RFI suppression system may be tested as follows:

a. Bring a radio-equipped vehicle within 25 feet of the truck to be tested. Shut off its engine and turn on its radio equipment for maximum sensitivity.

b. Turn on the radio equipment in the test truck, if so equipped.

c. Start the truck engine and turn on all auxiliary equipment. No increase in background noise in either truck radio equipment or the nearby vehicle should be heard.

d. If noise is heard in either radio equipment, turn off or disconnect electrical generating or operating components one at a time until noise stops.

e. When a component is found which causes radio interference, check it carefully for loose connections, secure mountings, missing toothed washers, or damaged or broken metal housing. The capacitors may be checked for leaks and shorts on a multimeter.

f. If the interference cannot be eliminated with thorough cleaning and minor repairs, replace the component.

g. If RFI is still present, repeat operation *d* above. More than one component may be causing interference.

Section VIII. ENGINE DESCRIPTION AND MAINTENANCE IN VEHICLE

2-31. Description

a. General. The M746 truck tractor is powered by a 12-cylinder, v-type, two-cycle, liquid cooled, compression ignition, diesel engine.

b. Lubricaton System. Moving parts of the engine are pressure lubricated. A gear-type pump draws oil from the oil pan through an intake screen, and delivers it to the oil filter and then to the oil cooler. From the oil cooler, the oil flows through passages that connect with the galleries in the cylinder block and cylinder heads for distribution to the bearings, rocker arm mechanism and other functional parts.

c. Fuel Injection System. Fuel is drawn from the fuel tank through the fuel strainer and enters the fuel pump at the inlet side. Leaving the fuel pump under pressure, the fuel is forced through the fuel lines and fuel filter into the upper fuel inlet manifolds (integral in the cylinder heads), then through fuel pipes into the inlet side of the fuel injectors. Surplus fuel returns from the outlet side of the fuel injectors, through outlet fuel pipes into the lower fuel outlet manifolds, and returns through fuel supply lines to the fuel tank. Since the fuel is constantly circulating through the injectors, it serves to cool the injectors and carry off any air in the fuel system.

d. Air Induction and Exhaust System. Air for scavenging and combustion is supplied, by two turbochargers, to two blowers which discharge into the engine cylinders through the air box and cylinder sleeve ports. All air entering the turbochargers first passes through the two air cleaners. The ether kit is provided as an aid for cold weather starting. Exhaust gases are routed from the engine through four valves provided for each cylinder, through exhaust ports in the cylinder heads, and to the air-cooled exhaust manifolds attached to each cylinder head. The exhaust gases are then routed through the turbochargers to the exhaust pipes.

e. Engine Nomenclature. The fan end of the engine will be referred to as the front. The transmission end will be referred to as the rear. The terms "left" and "right" as used with reference to the engine, are as viewed from the rear of vehicle, looking forward.

2-32. Tabulated Data

See TM 9-2320-258-10.

2-33. List of Operations Performed with Engine in the Vehicle

All organizational maintenance operations on the engine and engine accessories must be performed with the engine installed in the vehicle. These maintenance operations, with reference to the specific paragraph for detailed instructions, are listed below.

a. Alternator (para 2-56)
b. Voltage regulator (para 2-58)
c. Starter (para 2-57)
d. Starter relay (para 2-64).
e. Fuel filters and elements (para 2-39)
f. Fuel lines and fittings (para 2-42)
g. Fuel shutoff solenoid (para 2-63)
h. Fuel pressure switch (para 2-41)
i. Winch PTO solenoid (para 2-102)
j. Oil filter elements (para 2-35)
k. Drain and fill engine oil (para 2-34)
l. Oil lines (external) (para 2-36)
m. Accelerator throttle linkage (para 2-45)
n. Fan and drive belts (para 2-51, 2-52)
o. Radiator hoses (para 2-53)
p. Thermostats (para 2-54)
q. Exhaust mufflers and cover assembly (para 2-47)
r. Air cleaner (para 2-44)
s. Sending units (para 2-61)
t. Air compressor and drive belts (para 2-128)
u. Air compressor governor (para 2-128)
v. Tachometer drive adapter (para 2-98)

2-34. Drain and Fill Engine Lube Oil

Fig. 2-52

a. Drain. Provide suitable container under engine oil pan and remove hexagon head magnetic drain plug. (Engine oil capacity is approximately 40 qts.)

b. Fill. Remove fill cap from tube on left engine rocker cover and add oil until required level is indicated on oil level gage.

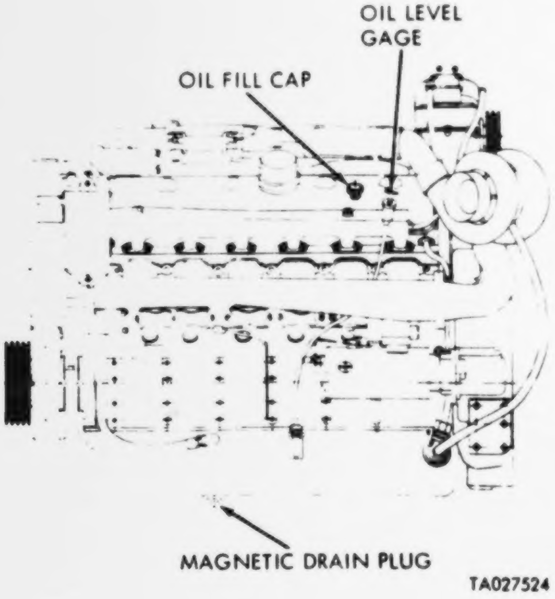


Figure 2-52. Engine oil — drain and fill locations.

2-35. Engine Oil Filter Assembly Fig. 2-53

a. Description. The engine is equipped with dual-mounted, full flow type, oil filters, which are mounted right of the engine on the shroud wall. Flexible lines connect the filter assembly to the engine oil cooler. The filter assembly consists of two replaceable elements enclosed within two shells. The shells are mounted on an adapter base. When the filter shells are in place, the elements are restrained from movement by coil springs. All oil supplied to the engine by the oil pump passes through the filter before reaching the various parts of the engine. Lubricating oil is forced by pump pressure through a passage in the filter adapter to the space surrounding the filter element. Impurities are filtered out as the oil is forced through the element to a central passage surrounding the center stud and out through another passge in the filter adapter and then to the oil cooler.

b. Replacement of Oil Filter Elements (fig. 2-53).

(1) Open drain cock (11) at bottom side of filter and drain filter.

(2) Back out shoulder bolt (13) and withdraw shell (10) and bolt as an assembly.

(3) Remove element and gasket (19) and discard.

(4) Remove retainer nut (18), retainer (17), washer (16), spring (14), and gasket (15). Inspect element gasket (19), and preformed packing (12) for damage.

(5) Inspect all parts for damage or excessive wear and replace as necessary.

(6) Use new filter elements with gaskets.

c. Assembly of Oil Filter Elements (fig. 2-53).

(1) Assemble gasket (15), spring (14), washer (16), and retainer (17), together and secure with retainer nut (18).

(2) Install new element and gasket (19).

(3) Insert shoulder bolt (13) into shell (10) and tighten bolt.

(4) Close drain cock (11) at bottom of filter.

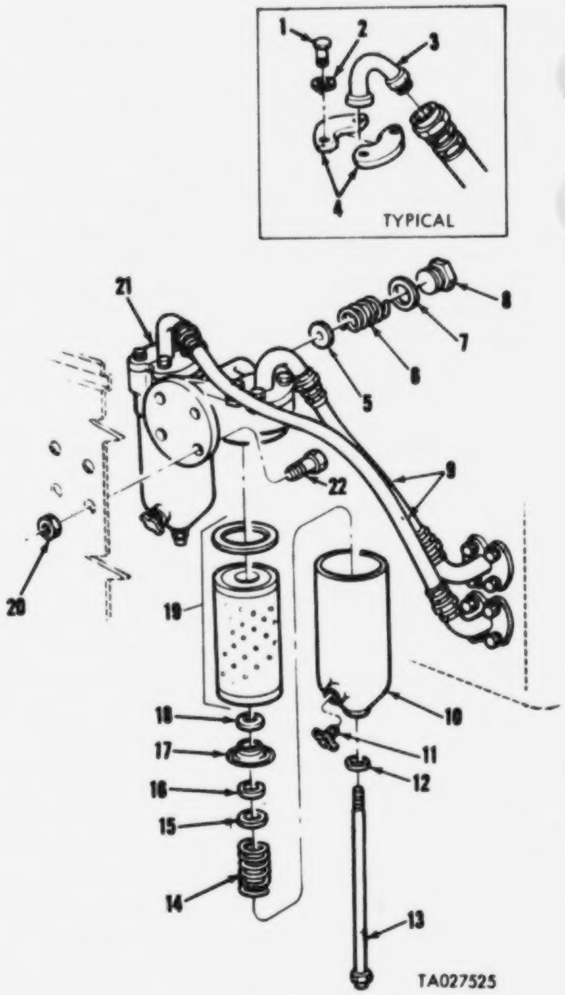
2-36. Engine Oil Lines (External)

Fig. 2-53

NOTE

Both oil lines are replaced in the same manner.

a. Removal and Disassembly. Drain oil from engine. Remove two clamps from each hose assembly at oil cooler by removing four nuts and lockwashers from each set of clamps. Separate elbows from oil cooler and remove packing. Remove two clamps from each hose assembly at oil filter assembly by removing four screws and lockwashers from each set of clamps. Remove hose assemblies with elbows. Remove packing from oil filter assembly ports. Remove elbow from each hose end by loosening nut (second nut away from elbow) securing elbow to hose fitting.



1 Screw (4)
2 Lockwasher (4)
3 Elbow
4 Clamp (2)
5 Disc (by pass valve)
6 Spring (by pass valve)
7 Gasket (by pass valve)
8 Plug (by pass valve)
9 Hose assemblies
10 Shell
11 Drain cock
12 Packing
13 Bolt, shoulder
14 Spring
15 Set gasket
16 Washer
17 Retainer
18 Nut
19 Element, filter
20 Nut (4)
21 Oil filter assembly
22 Screw (4)

Figure 2-53. Engine oil filter assembly — partially exploded view.

b. Assembly and Installation. To assemble hose to elbows attach elbow at each hose end by tightening second nut away from elbow to secure elbow to hose fitting. Attach four screws and lockwashers to each set of clamps at oil filter assembly and secure clamps. Apply packing and secure elbows to oil cooler. Attach four nuts and lockwashers at each set of clamps and apply clamps to each hose assembly at oil cooler. Add oil to engine. Tighten nuts or screws, attaching elbow clamps, between 64 and 70 lb.-ft. torque. Fill engine with oil prescribed in LO 9-2320-258-12 to "full" mark on oil level gage (fig. 2-52). Start engine and check external oil lines for leaks. Run for five minutes and recheck engine oil level.

2-37. Air Box Drain Tubes

a. General. Air box drains must be open at all times; otherwise, water and oil may accumulate in the air box and be drawn into the cylinders with incoming fresh air. Tow air box drain tubes are located on each side of the engine and are exposed at the bottom of the engine. The two air box drain tubes on the right side are positioned between the engine and the oil coolers.

b. Cleaning. Clean four air box drain tubes semiannually using brush CPR109386.

Section IX. FUEL SYSTEM AND AIR INDUCTION SYSTEM

2-38. Description and Data

a. General. The fuel system consists basically of a fuel tank, the engine driven main fuel pump, the electric auxiliary fuel tank mounted fuel pump, fuel filter, a fuel strainer, fuel injectors and necessary controls, plus linkage and fuel lines to operate the system. An ether kit is also provided to aid in cold weather starting. The air induction system consists of two air cleaners, two turbo-chargers, and interconnecting hoses.

b. Operation (fig. 2-54). Fuel is drawn from the fuel tank, and through the fuel strainer by the gear-type main fuel pump. This pump then forces the fuel oil through the filter and through the engine fuel inlet galleries in the cylinder heads to the injectors. Excess fuel is returned to the fuel tank via the return fuel galleries and connecting lines. Since fuel is constantly circulated through the injectors, it serves to cool the injectors and carry off any air in the fuel system.

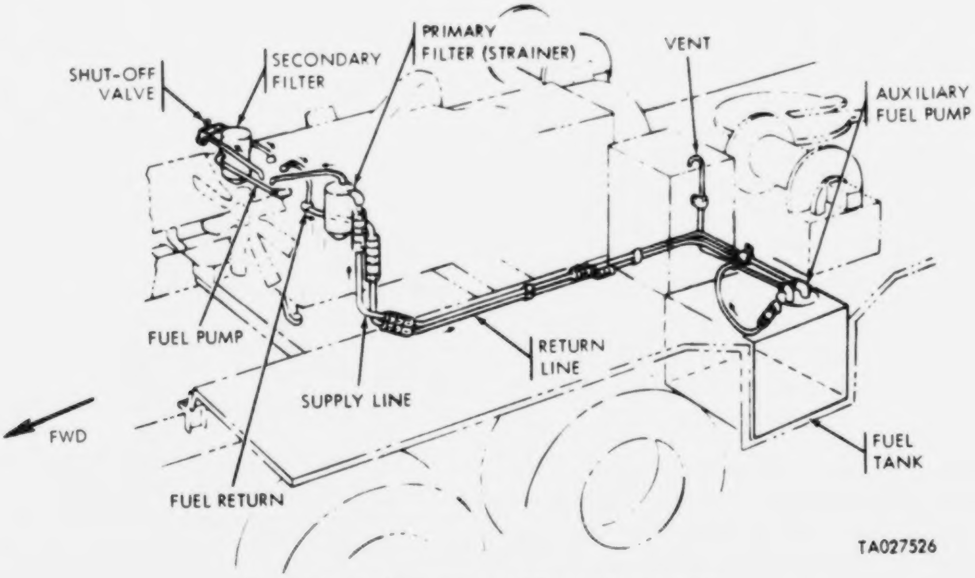


Figure 2-54. Fuel system external lines and components.

c. Accelerator Throttle Controls. Fuel throttle control is conducted from the cab by (1) the accelerator foot pedal, and (2) by the engine stop switch. The foot pedal is connected to the engine governor by a control cable assembly (fig. 2-63). The engine stop switch is connected electrically to the fuel shutoff solenoid at the governor. Fuel throttle control is conducted from the winch station by a push-pull knob and control cable assembly that is also connected to the engine governor.

d. Air Cleaners. Air for scavenging and combustion is first drawn through the air cleaners by the engine blowers. The air cleaners (fig. 2-60) are the two-stage, dry type, with a centrifugal air cleaner combined with a replaceable paper filter. A removable dust collector at the bottom of the metal case assembly is serviced daily. Serviceability of the air cleaners is monitored in the vehicle cab by two gages (A, fig. 2-62) which are connected by tubing to each air cleaner. Air flows from the air cleaners to the turbo-chargers through two large tubes.

e. Auxiliary Fuel Pump. The electric (in-tank) fuel pump, activated by a switch in the cab, boosts fuel supply pressure when required. The engine will run, even if the switch is off, with the main gear driven pump supplying fuel. The in-tank pump must be on though, if the fuel lines are dry when the engine is being started.

f. Fuel Pressure Switch. The fuel pressure switch, mounted on the fuel filter, is part of the starter system and prevents the starter from being engaged when the engine is running. The fuel pressure switch is normally closed but opens at approximately 20 psi fuel pressure. When closed, current flows to the starter relay and thus to the starter solenoid and starter motor. When open, because fuel pressure has reached approximately 20 psi, current to the starter motor is stopped.

g. Personnel Heater Fuel Pump. The personnel heater electric fuel pump has its own filter and draws fuel oil from the fuel tank.

h. Ether Kit. The ether kit is used as an aid in starting the engine when ambient temperature is below 40°F. A switch on the cab right instrument panel controls a solenoid attached to the ether kit control linkage. The ether kit control linkage opens or closes the ether valve to deliver a measured amount of ether from the bottle to engine.

i. Tabulated Data. Refer to paragraph 1-7*b*.

2-39. Fuel Filter and Fuel Strainer.

a. General. A replaceable density-type element fuel strainer and replaceable paper-type element fuel filter are used in the fuel system to remove impurities from the fuel. The strainer element removes foreign particles larger than 30 microns (one micron equals 0.00004 inch) and the filter element removes particles larger than 10 microns. The strainer is located between the fuel tank and the fuel pump (primary lines), and the filter is located between the fuel pump and the fuel inlet manifold (secondary lines).

b. Replacement of Fuel Filter and Strainer Elements (Fig. 2-55 and 2-56).

(1) With the engine shut down, place a suitable container under the fuel strainer or filter and open drain cock to drain fuel. Fuel will drain faster if cover nut is loosened.

CAUTION

The wiring harness, starting motor, or other electrical equipment must be shielded during filter change, since fuel oil can permanently damage the electrical insulation.

(2) Support shell, unscrew cover nut, and remove shell and element.

(3) Remove and discard element and gasket. Clean shell with fuel oil and dry it with a cloth or compressed air.

(4) Place a new element over stud and down against seat. Make sure drain cock is closed, then fill shell two-thirds full with clean fuel oil.

NOTE

Thoroughly soak strainer element in clean fuel oil before installing it. This will expel any air trapped in the element which could interfere with easy initial engine start.

(5) Install a new gasket in the recess of the shell.

(6) Place shell and element in position under cover.

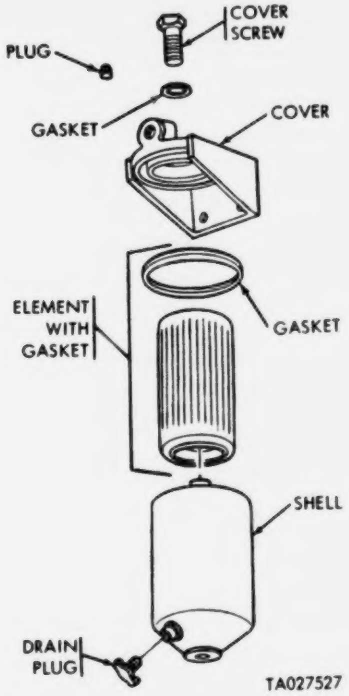


Figure 2-55. Fuel strainer — exploded view.

Then, with a new gasket over cover bolt, thread bolt (or nut) into the stud. With the shell and gasket properly positioned, tighten cover bolt or nut just enough to prevent fuel leakage.

(7) Remove filler plug in cover and complete filling of shell with fuel.

(8) Start engine and check fuel system for leaks.

NOTE

Change fuel elements and strainer elements every 6,000 miles or semiannually, whichever occurs first, or more often as dictated by conditions.

2-40. Fuel System Air Leaks and Fuel Flow Checks.

a. General. Because fuel is drawn to the fuel pump and thus through the primary filter by suction, the primary side of the fuel system is most susceptible to air leaks. On the other hand, the secondary side of the fuel system is under pressure and would most likely be affected by fuel leakage.

b. Air Leaks. Check for air leaks while making fuel flow check (c below). If leakage is evident, tighten all connections on the primary side and inspect primary filter gasket for damage and distortion. Replace gasket if required.

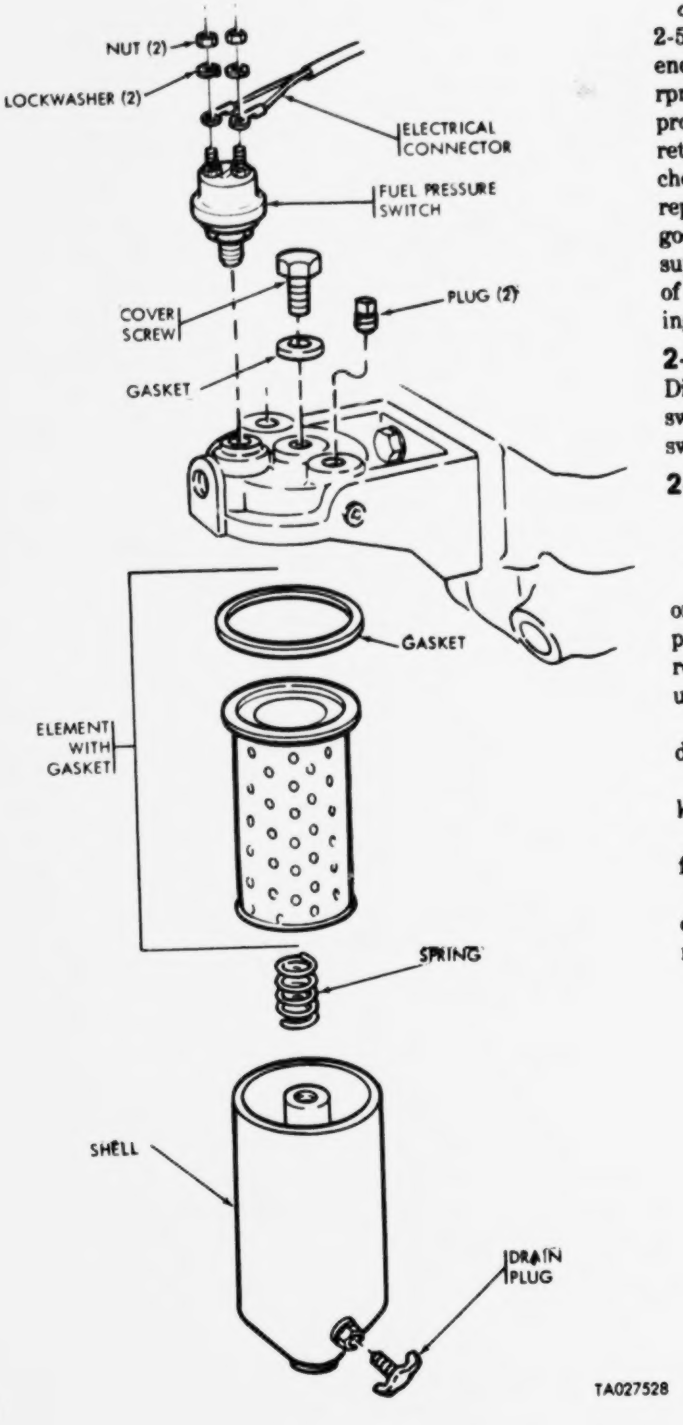


Figure 2-56. Fuel Filter — exploded view.

c. ***Fuel Flow Check.*** Disconnect fuel return line (fig. 2-57 and 2-58) from fitting at fuel tank and hold open end in a convenient receptacle. Run engine at 1200 rpm for one minute and measure amount of fuel. Approximately ½ gallon of fuel should flow from the return hose per minute. If fuel flow is insufficient, check primary and secondary fuel filter elements and replace either or both if clogged. If fuel filters are in good condition, fuel pump is probably faulty. Notify support personnel. During this operation, immerse end of hose into container and look for air bubbles indicating air leak on suction side.

2-41. Replacement of Fuel Pressure Switch

Disconnect electrical lead at switch and unscrew switch from filter assembly (fig. 2-56). To install, screw switch on filter and connect electrical lead.

2-42. Fuel Tank, Lines, and Fittings

Figs. 2-57 through 2-59

a. *Lines and Fittings.*

(1) Refer to figures 2-57 and 2-58 when removing or installing fuel system lines and fittings. Do not use pliers on fittings. Use only suitable wrench. When removing or installing fuel hose assemblies at engine, use suitable wrench.

(2) When disconnecting a fuel line, catch fuel drainage in a suitable container.

(3) Never kink a fuel line when installing. Replace kinked or clogged tubing.

(4) Clamp installed tubing in place as shown in figure 2-57.

(5) After fuel lines are installed, start engine and check lines for fuel leakage. If leak is found, tighten or replace fitting.

1 Adapter
2 Tube assembly
3 Screw
4 Bracket
5 Clamp (4)
6 Screw (2)
7 Nut (6)
8 Elbow
9 Hose assembly
10 Union (2)
11 Tube assembly
12 Tube assembly
13 Screw (2)
14 Clamp
15 Clamp
16 Screw (2)
17 Bracket
18 Clamp (2)
19 Lockwasher (3)
20 Screw (3)
21 Union (2)
22 Hose assembly
23 Tube assembly
24 Elbow
25 Adapter
26 Hose assembly
27 Valve (2)
28 Nipple (2)
29 Elbow, 90°

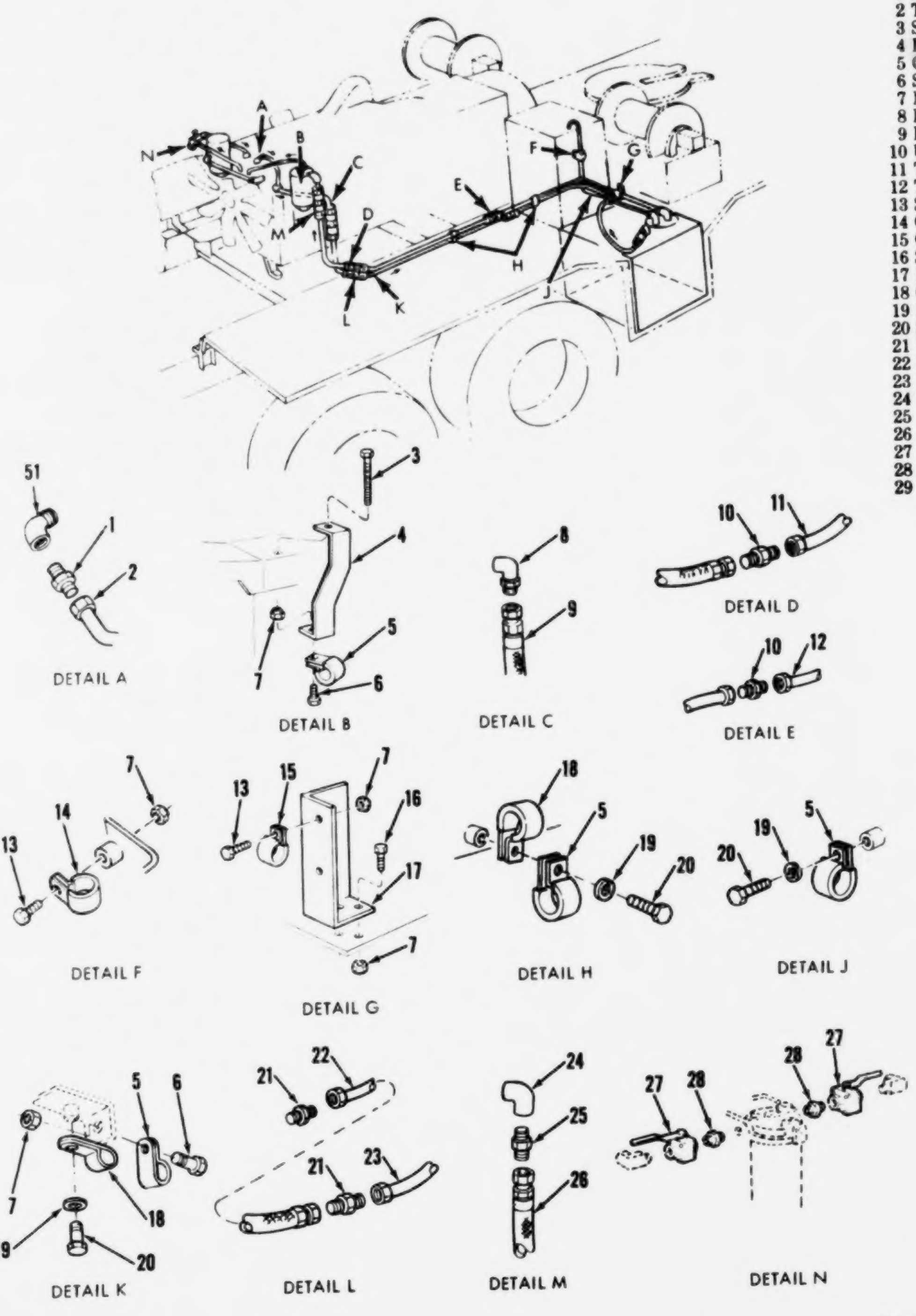
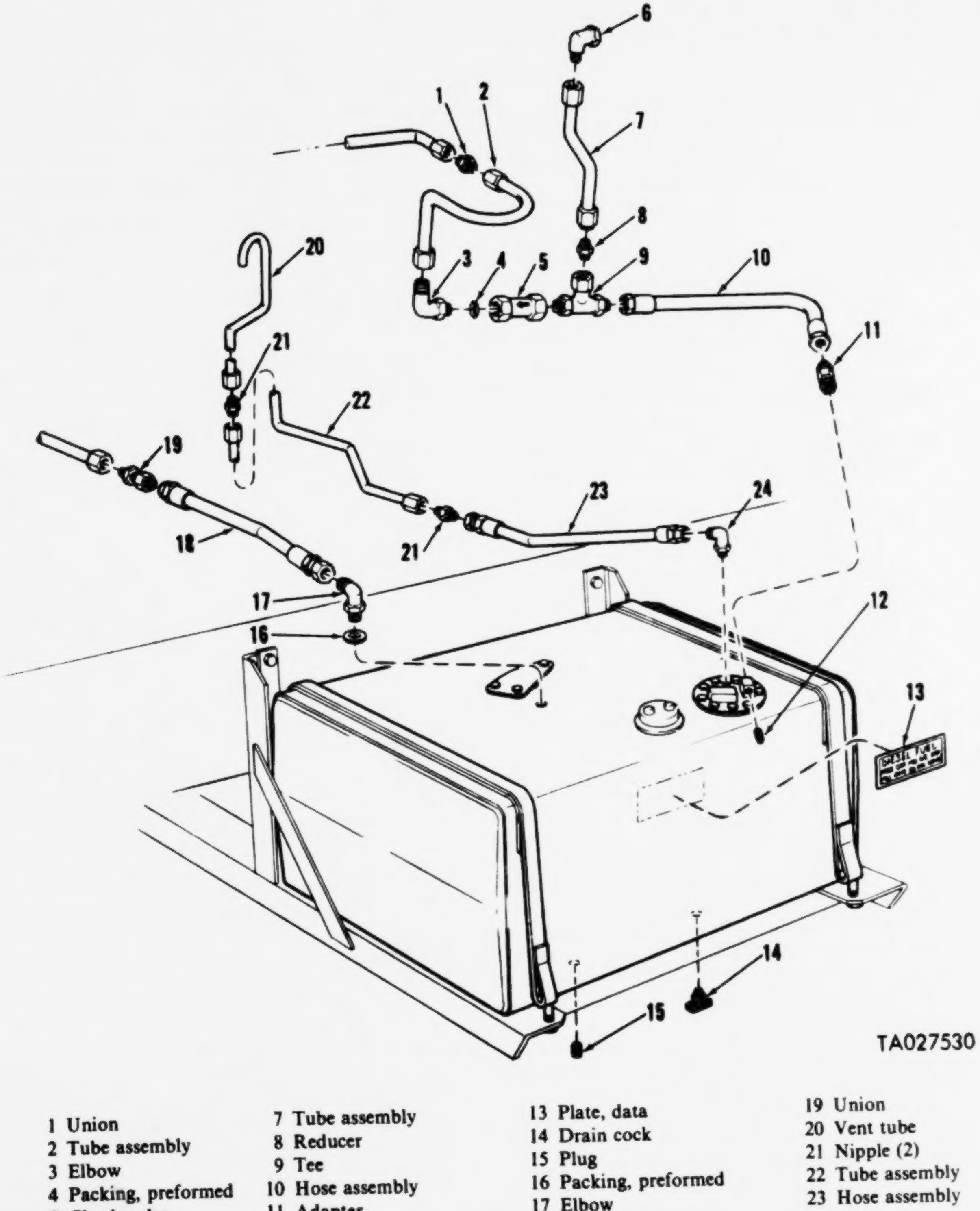

A
N
B
C
M
D
E
F
G
H
J
L
K
51
1
2
DETAIL A
3
4
5
7
6
DETAIL B
8
9
DETAIL C
10
11
DETAIL D
10
12
DETAIL E
7
14
13
DETAIL F
13
15
7
16
17
7
DETAIL G
18
5
19
20
DETAIL H
19
5
20
DETAIL J
5
6
7
18
19
20
DETAIL K
21
22
21
23
DETAIL L
24
25
26
DETAIL M
27
28
28
27
DETAIL N
TA027529

Figure 2-57. Fuel system lines and fittings.


6
1
2
7
8
20
3
4
5
9
10
11
21
22
19
23
24
18
21
17
16
12
13
DIESEL FUEL
14
15
TA027530

1 Union
2 Tube assembly
3 Elbow
4 Packing, preformed
5 Check valve
5 Elbow

7 Tube assembly
8 Reducer
9 Tee
10 Hose assembly
11 Adapter
12 Plug

13 Plate, data
14 Drain cock
15 Plug
16 Packing, preformed
17 Elbow
18 Hose assembly

19 Union
20 Vent tube
21 Nipple (2)
22 Tube assembly
23 Hose assembly
24 Elbow

Figure 2-58. Fuel tank and related parts.

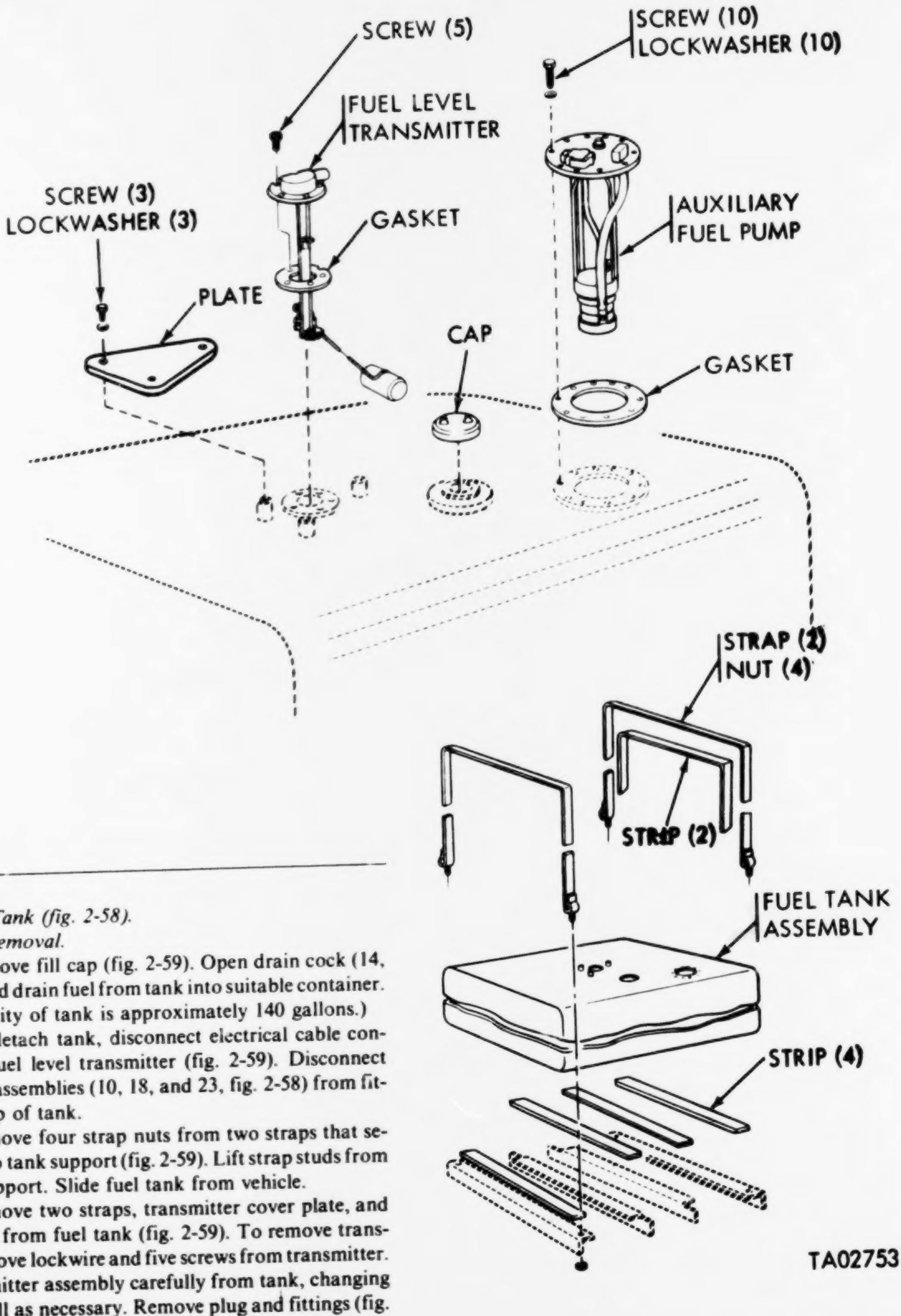

SCREW (5)
SCREW (10)
LOCKWASHER (10)
FUEL LEVEL
TRANSMITTER
SCREW (3)
LOCKWASHER (3)
GASKET
AUXILIARY
FUEL PUMP
PLATE
CAP
GASKET
STRAP (2)
NUT (4)
STRIP (2)
FUEL TANK
ASSEMBLY
STRIP (4)
TA027531

Figure 2-59. Fuel tank fill cap, filler neck and fuel level transmitter.

b. Fuel Tank (fig. 2-58).

(1) *Removal.*

(a) Remove fill cap (fig. 2-59). Open drain cock (14, fig. 2-58) and drain fuel from tank into suitable container. (Fuel capacity of tank is approximately 140 gallons.)

(b) To detach tank, disconnect electrical cable connector at fuel level transmitter (fig. 2-59). Disconnect three hose assemblies (10, 18, and 23, fig. 2-58) from fittings on top of tank.

(c) Remove four strap nuts from two straps that secure tank to tank support (fig. 2-59). Lift strap studs from holes in support. Slide fuel tank from vehicle.

(d) Remove two straps, transmitter cover plate, and transmitter from fuel tank (fig. 2-59). To remove transmitter, remove lockwire and five screws from transmitter. Pull transmitter assembly carefully from tank, changing angle of pull as necessary. Remove plug and fittings (fig. 2-58) that remain installed in tank. Remove auxiliary fuel pump (fig. 2-59) by removing ten screws and lockwashers. Pull pump assembly carefully from tank. Remove pump gasket.

(2) *Installation.*

(a) Install new pump gasket on pump assembly and carefully position pump assembly to tank. Install ten screws and lockwashers to secure pump assembly to tank.

(b) Install plug and fittings in tank.

(c) Position transmitter assembly and new gasket carefully to tank and secure transmitter by installing five screws and lockwire. Install transmitter cover plate and two straps.

(d) Position fuel tank on fuel tank supports. Install four strap nuts to two straps that secure tank to tank support.

(e) Connect three hose assemblies (10, 18, and 23, fig. 2-58) to fittings on top of tank. Connect electrical cable connector at fuel level transmitter.

(f) Close drain cock (14). Fill fuel tanks (capacity is about 140 gallons) and install fill cap.

2-43. Auxiliary Fuel Pump

Fig. 2-59

(a) Removal Refer to figure 2-59 and disconnect electrical connections from pump. Remove ten screws and washers securing pump to tank and remove pump. Remove gasket.

(b) Installation. Install new gasket. Position pump in tank and secure with ten screws and lockwashers. Attach electrical connector.

2-44. Air Cleaners

Figs. 2-60 through 2-62

NOTE

Procedures given are for the left air cleaners. Procedures for the right air cleaner are similar.

a. Removal (fig. 2-60).

(1) Loosen clamp securing air tube assembly and gasket to air cleaner. Disconnect tube elbow.

(2) Disconnect air hose assembly at deck by removing nut from fitting at deck.

(3) Remove four screws and nuts securing air cleaner to mounting bracket, and remove air cleaner.

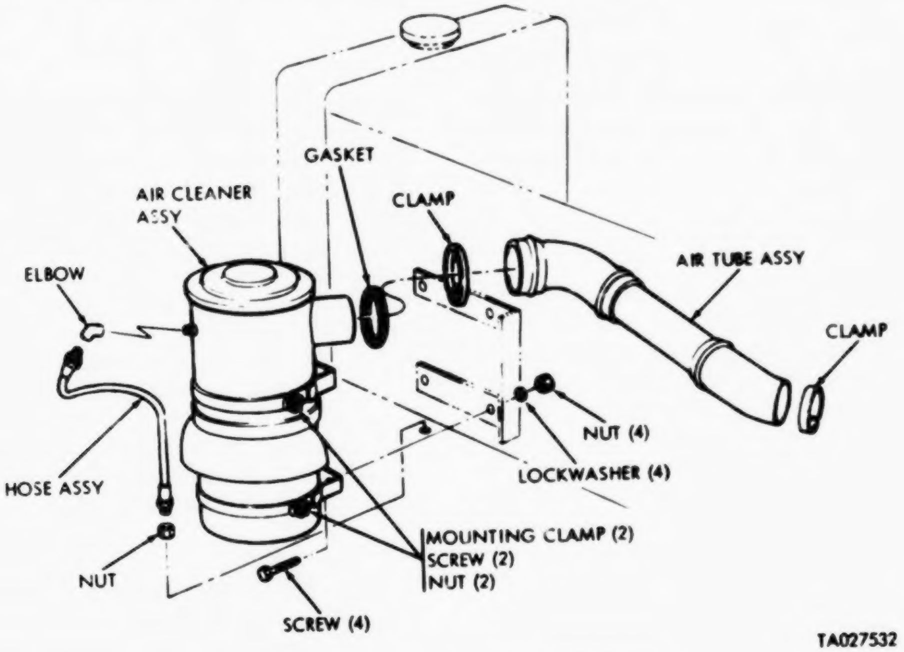


Figure 2-60. Removal and installation of air cleaner.

b. Disassembly (fig. 2-61). Release four clip springs from cover, remove cover, and remove thumb screw. Loosen body clamp and cup clamp assemblies. Separate components referring to figure 2-61.

CAUTION

Do not pry inner cover off the element when cold weather causes tight fit. Warm assembly by normal exposure to room temperature; then, inner cover can be easily pulled off.

c. Clean and Inspect.

(1) *Removal.* Dust off outer cover and remove. Remove thumb screw. Remove inner cover and element carefully to prevent dust from falling into clean air space around filter.

CAUTION

Inner cover may stick to the element due to temerature change. It is not necessary to remove inner cover for servicing element.

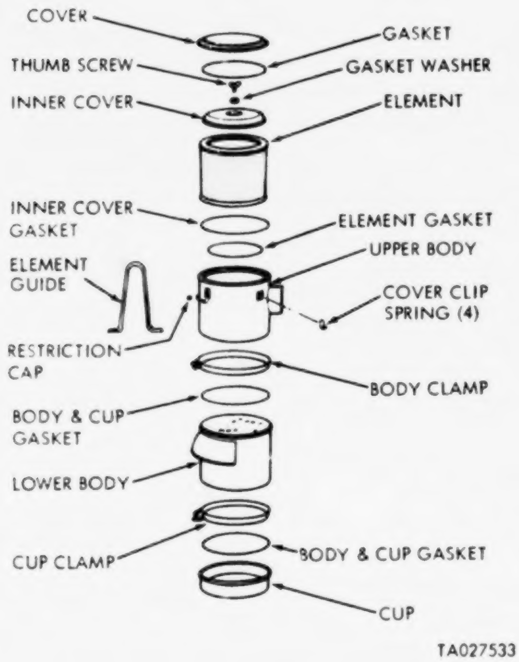


Figure 2-61. Air cleaner - exploded view.

If element must be replaced, be sure to retain inner ring. Do not pry the inner cover off the element. A snug fitting inner cover may be removed easily at room temperature (minimum 60°F).

(2) *Cleaning.*

CAUTION

Before cleaning element, install outer cover to protect induction system while cleaning element.

To clean filter element, direct dry, clean air at maximum pressure of 100 psi up and down the pleats on the clean air side of the filter, using a ⅛-inch nozzle until all dust is removed, or wash with non-sudsing detergent and water. Soak for 15 minutes, then rinse the filter thoroughly with clean water from a hose (maximum pressure 40 psi). Air dry completely before reusing. After the element has been dried (a fan or air draft may be used, but do not heat element to speed drying), inspect element for damage by placing a bright light inside the filter. If thin spots, pin holes, or the slightest rupture are detected, the cartridge (filter) will have to be replaced. Light dust plugging of tubes can be removed with a stiff fibre brush. If heavy plugging with fibrous material is evident, remove lower body for cleaning with compressed air, or water at a temperature not exceeding 150°F. Inspect all gaskets. Replace gaskets if worn or damaged.

(3) *Installation.* Install element and inner cover carefully. Install thumb screw and outer cover.

CAUTION

Do not use oil in dust cup. Be sure dust cup fits air tight to lower body when installing.

(4) *Inspect.* Inspect gaskets for damage or excessive wear. Replace if required. Inspect gasket channels in components for damage. Make sure top cover clip springs work properly and hold cover firmly. Inspect all nonfiltration parts for punctures or distortions that would cause leaks. Inspect tubes in lower body assembly for damage or plugging. Inspect filter element for leaks indicated by areas of concentrated dust on clean air side of cartridge or by light shining through holes when light bulb is held inside cartridge.

CAUTION

Filter should be replaced after six cleanings or annually

d. Assembly. Tighten body clamp and cup clamp assemblies. Gather components referring to figure 2-61. Be sure to tighten body clamp before installing air cleaner on vehicle.

e. Installation.

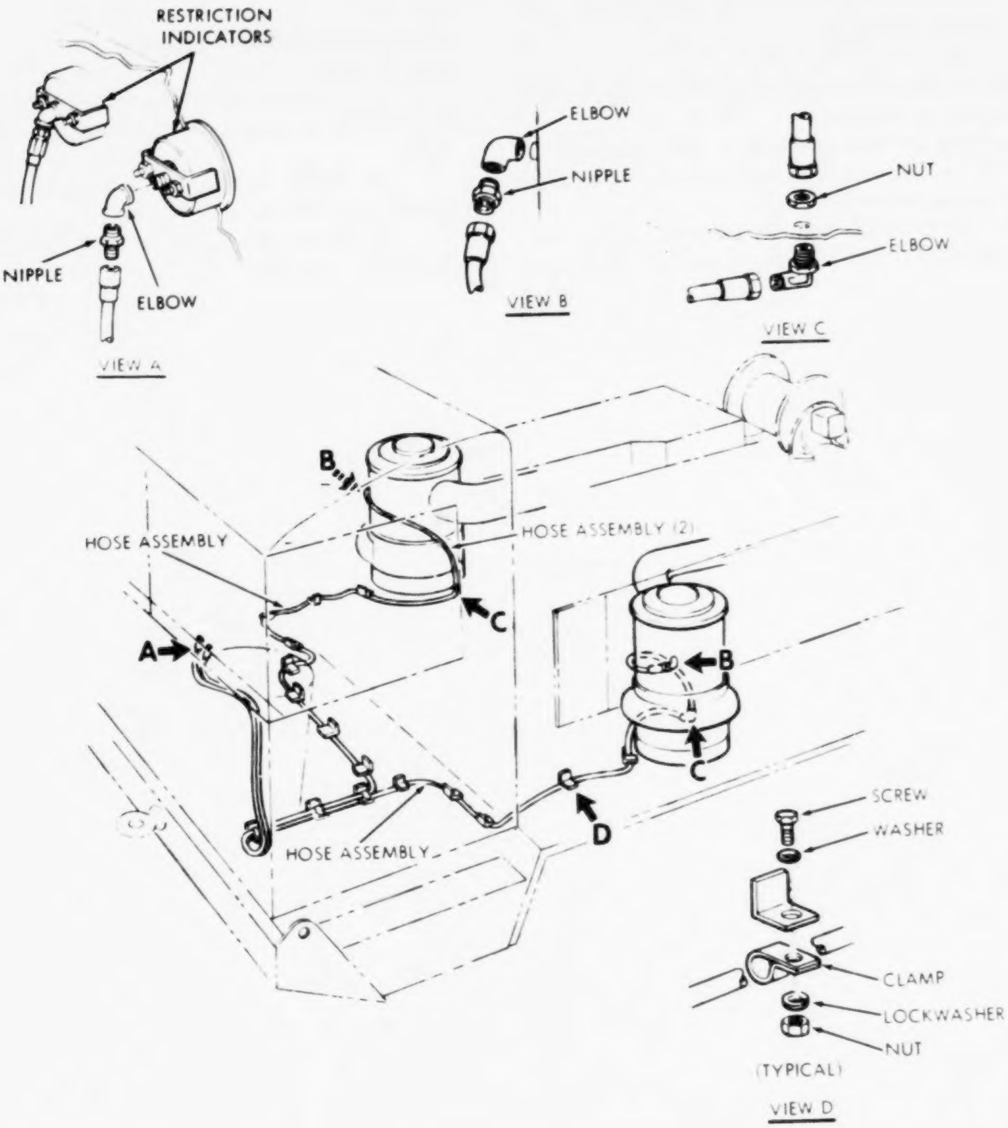
(1) Position air cleaner on mounting bracket and install four screws and nuts.

(2) Connect air tube assembly and gasket to air cleaner with clamp.

(3) Connect air hose assembly at deck by installing nut to fitting at deck.

f. Air Tube Assembly. Remove air tube assembly by loosening clamps at either end of tube assembly and disconnecting rubber elbows. Replace rubber elbows or aluminum tube if damaged. These parts must not leak air. Install air tube assembly by connecting rubber elbows and tightening clamps at either end of tube assembly.

g. Cab Air Cleaner Air Indicators and Feed Line Assemblies. Refer to figure 2-62 and replace parts as required.


RESTRICTION INDICATORS
NIPPLE
ELBOW
VIEW A
ELBOW
NIPPLE
VIEW B
NUT
ELBOW
VIEW C
B
HOSE ASSEMBLY
HOSE ASSEMBLY (2)
C
A
B
C
D
HOSE ASSEMBLY
SCREW
WASHER
CLAMP
LOCKWASHER
NUT
(TYPICAL)
VIEW D

TA027534

Figure 2-62. Air cleaner indicators and feed line installation.

2-45. Accelerator Throttle Controls and Linkage

Figs. 2-63 through 2-67

a. Disassembly. Refer to illustrations and disassemble as shown and as required.

b. Servicing of Throttle Control Cable Assembly.

(1) Clean all parts with dry-cleaning solvent. Blow dry with compressed air.

(2) Inspect cable assembly for nicks, cracks, corrosion, stripped or worn threads, or any other defect that might impair efficient operation.

c. Assembly.

(1) Assemble accelerator controls and linkage as shown. Clamp control cables securely to avoid throttle bind.

(2) Adjust accelerator linkage at pedal during assembly (*d* below).

(3) Adjust accelerator linkage at engine during assembly (*e* below).

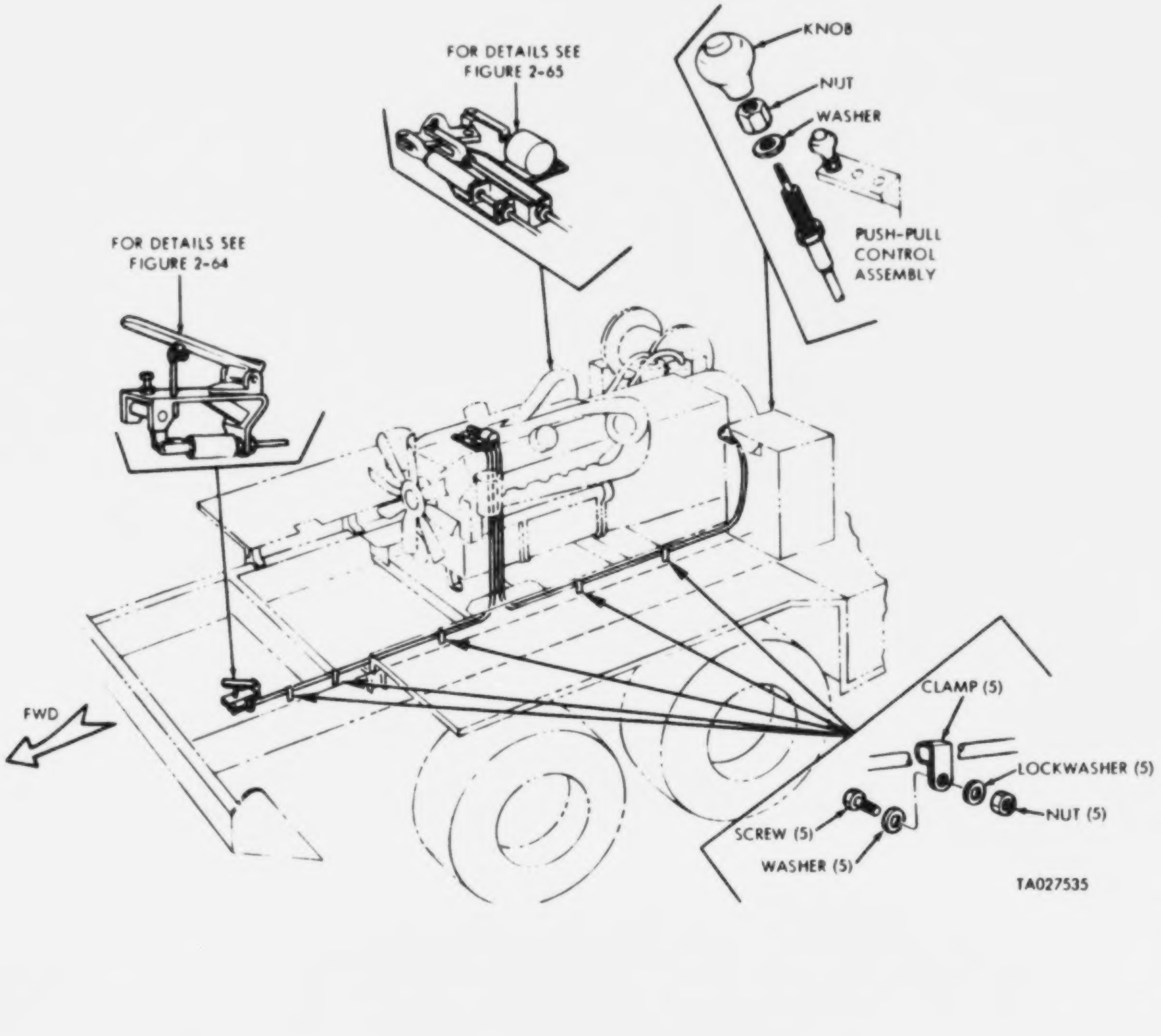
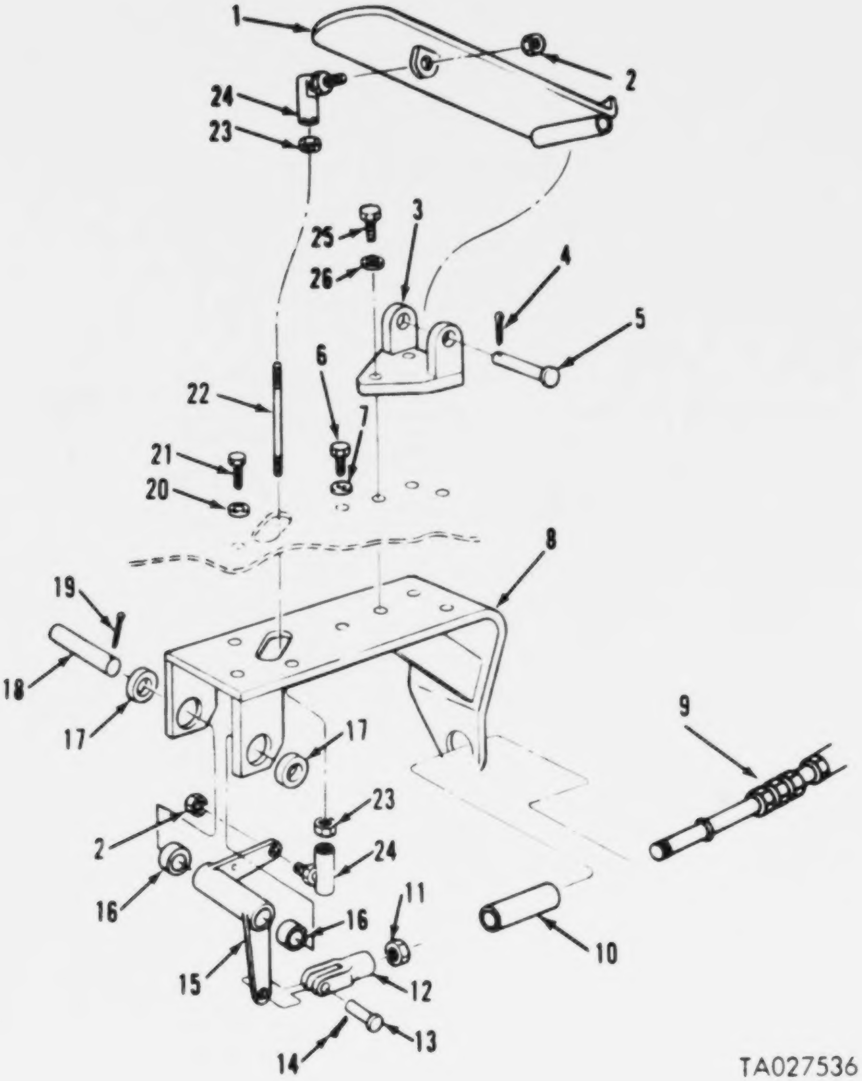

FOR DETAILS SEE FIGURE 2-65
KNOB
NUT
WASHER
PUSH-PULL CONTROL ASSEMBLY
FOR DETAILS SEE FIGURE 2-64
FWD
CLAMP (5)
LOCKWASHER (5)
NUT (5)
SCREW (5)
WASHER (5)
TA027535

Figure 2-63. Accelerator throttle controls and linkage.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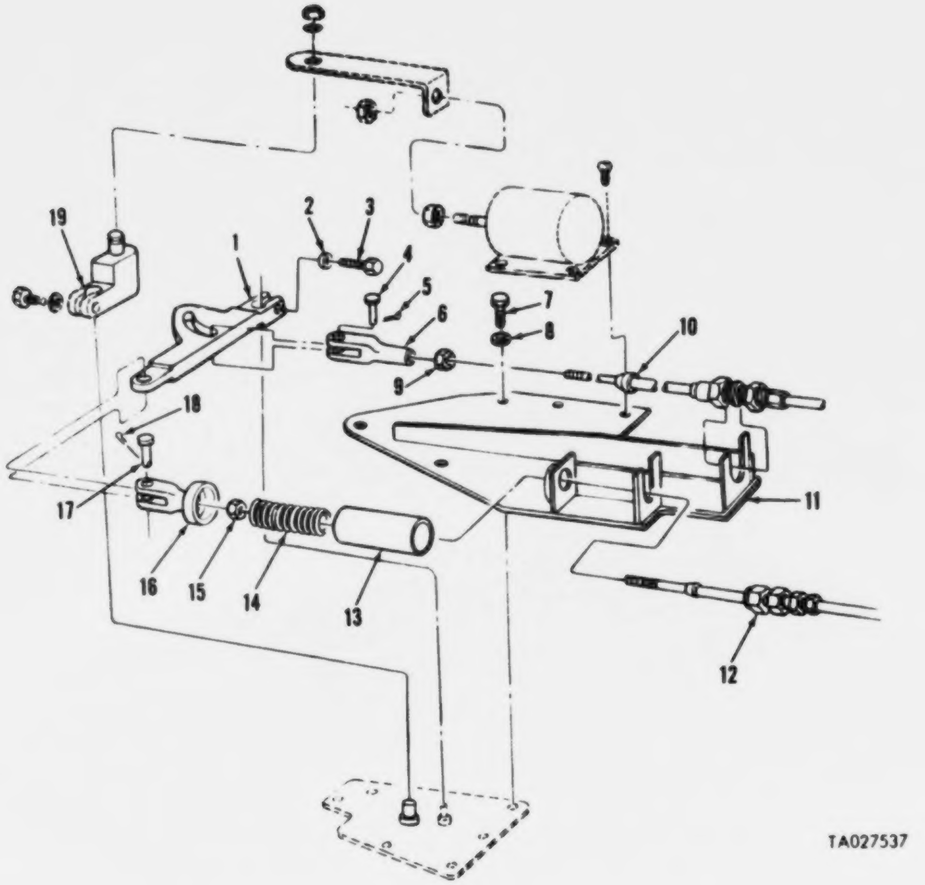
TA027536

1 Pedal
2 Nut (4)
3 Bracket
4 Cotter pin
5 Pin
6 Screw (4)
7 Washer (4)
8 Bracket
9 Control cable assembly
10 Rubber boot
11 Nut
12 Clevis
13 Pin
14 Cotter pin
15 Bellcrank
16 Bearing (2)
17 Spacer (2)
18 Shaft
19 Pin
20 Nut
21 Screw (pedal stop)
22 Rod
23 Nut
24 Ball joint (2)
25 Screw (3)
26 Lockwasher (3)

Figure 2-64. Accelerator pedal and linkage — exploded view.



1 Lever
2 Lockwasher
3 Screw
4 Pin
5 Cotter pin
6 Clevis
7 Screw (4)
8 Lockwasher (4)
9 Nut
10 Control assembly, push-pull (winch station)

11 Bracket
12 Control cable (accelerator pedal)
13 Rubber boot
14 Spring
15 Nut
16 Retainer
17 Pin
18 Cotter pin
19 Lever

Figure 2-65. Accelerator linkage at engine — exploded view.

d. Adjustment of Accelerator Linkage at Pedal (fig. 2-66).

(1) Adjust rod and ball joint assembly length to 4.89 ± .03 inches between centers of ball joints.

(2) For correct idle position of pedal, ⅛-inch holes in bracket and bell crank must coincide.

(3) Adjust full throttle limit screw to approximately 1.78-inch above floor, then tighten jamnut.

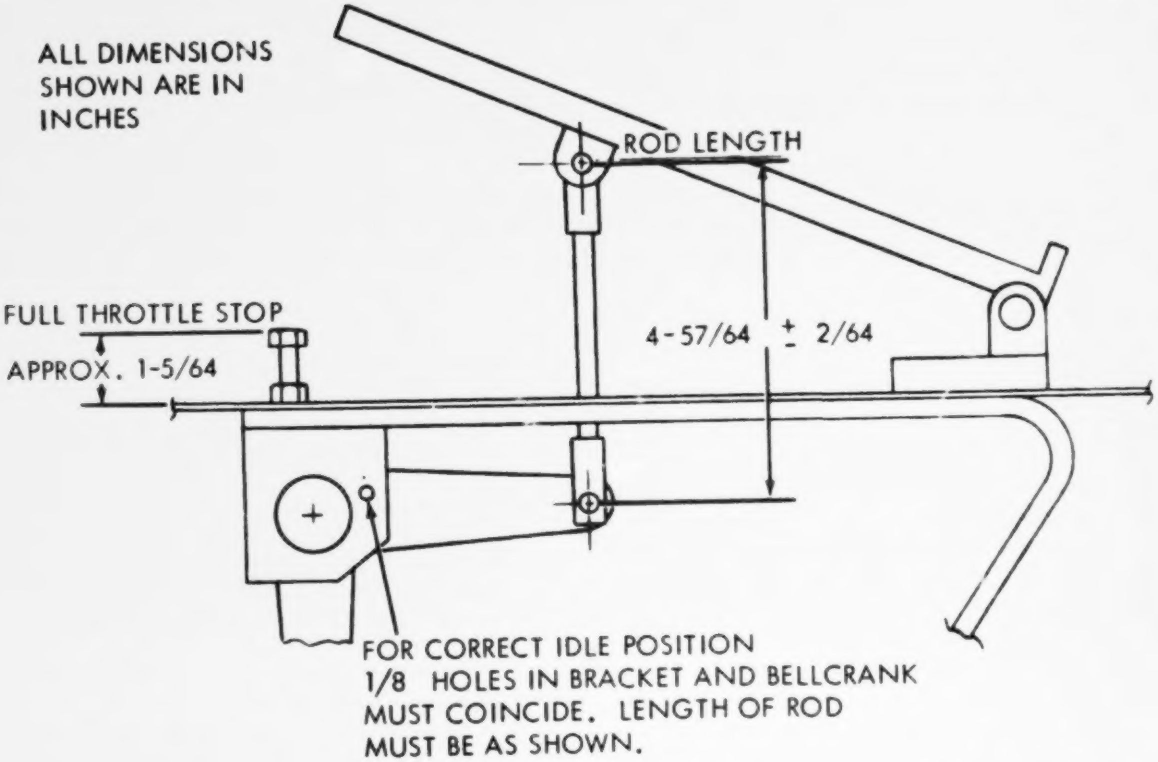

ALL DIMENSIONS SHOWN ARE IN INCHES
ROD LENGTH
FULL THROTTLE STOP
APPROX. 1-5/64
4-57/64 ± 2/64
FOR CORRECT IDLE POSITION 1/8 HOLES IN BRACKET AND BELLCRANK MUST COINCIDE. LENGTH OF ROD MUST BE AS SHOWN.
TA027538

Figure 2-66. Adjustment of accelerator linkage at pedal.

e. Adjustment of Accelerator Linkage at Engine (fig. 2-67).

(1) The fuel shutoff solenoid lever (19, fig.2-65) and governor control lever (1) are each keyed to a fixed position on the respective governor posts. No adjustments are therefore required of these levers. Both levers should, however, be tight on their posts.

(2) Assure that push-pull cable knob at winch station is pushed all the way in.

(3) Remove cotter pins (5 and 18) and pins (4 and 17).

(4) Observe that holes in clevis end of spring retainer (16) aline with hole in lever. Lever cannot move to right beyond its idle position (fig.2-68). If holes in clevis end of spring retainer do not aline with hole in lever, loosen locknut, bend control cable assembly until retainer clevis end is free of lever, and thread retainer in or out until proper length is achieved for hole alinement. Install pin and cotter pin (17 and 18, fig. 2-65) and tighten locknut.

(5) Observe that holes in winch push-pull cable clevis are alined with slot end of lever while lever is in idle position. If clevis holes are alined with slot end or slightly to the right of slot end, install pin and cotter pin (4 and 5, fig. 2-65). If clevis holes are to left of slot end, loosen nuts securing push-pull cable to bracket and retighten when proper cable length is achieved for hole alinement.

CAUTION

If clevis holes of either control cable are badly misalined to the left, check both cables carefully for improper installation or severe bends.

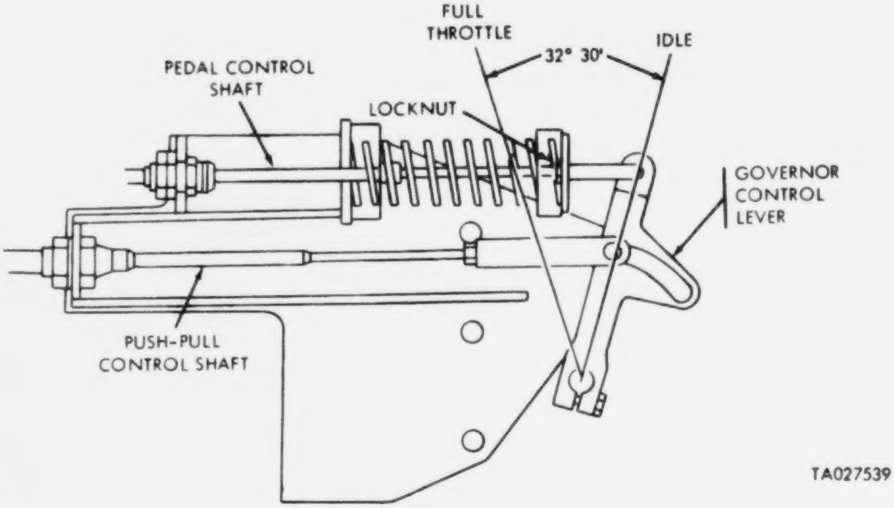

FULL THROTTLE
IDLE
32° 30'
PEDAL CONTROL SHAFT
LOCKNUT
GOVERNOR CONTROL LEVER
PUSH-PULL CONTROL SHAFT
TA027539

Figure 2-67. Adjustment of accelerator linkage at engine.

f. Replacement of Fuel Shut-Off Solenoid. Refer to paragraph 2-67.

2-46. Ether Kit

Figs. 2-68 and 2-69

WARNING

Ether fumes are extremely flammable. Perform next test in well ventilated area away from extreme heat or flames.

a. Ether Kit Test (fig. 2-68).

(1) Assure electrical portion of ether system is functioning properly. Refer to Electrical Troubleshooting, table 2-14.

(2) Remove ether kit cover (33, fig. 2-69) by removing three screws, lockwasher, and washers.

(3) Disconnect ether lines from blower intake manifolds. (Do not remove atomizers.) Assure line open-

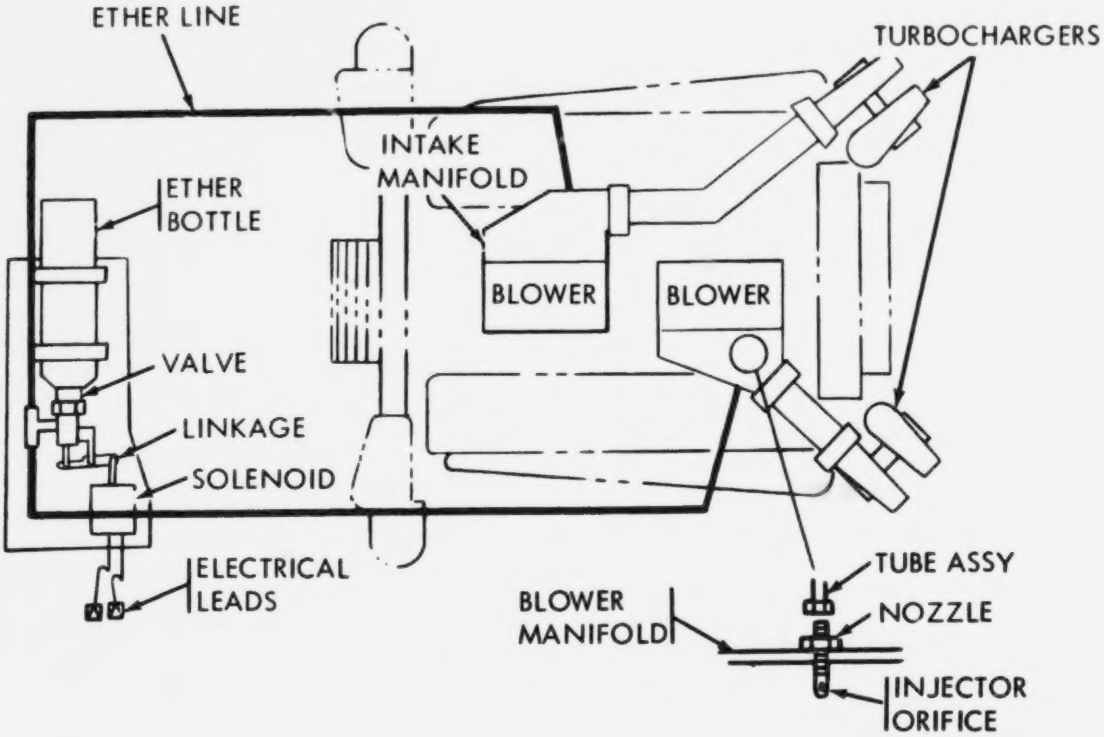

ETHER LINE
TURBOCHARGERS
INTAKE MANIFOLD
ETHER BOTTLE
BLOWER
BLOWER
VALVE
LINKAGE
SOLENOID
ELECTRICAL LEADS
TUBE ASSY
NOZZLE
BLOWER MANIFOLD
INJECTOR ORIFICE

Figure 2-68. Ether kit schematic.

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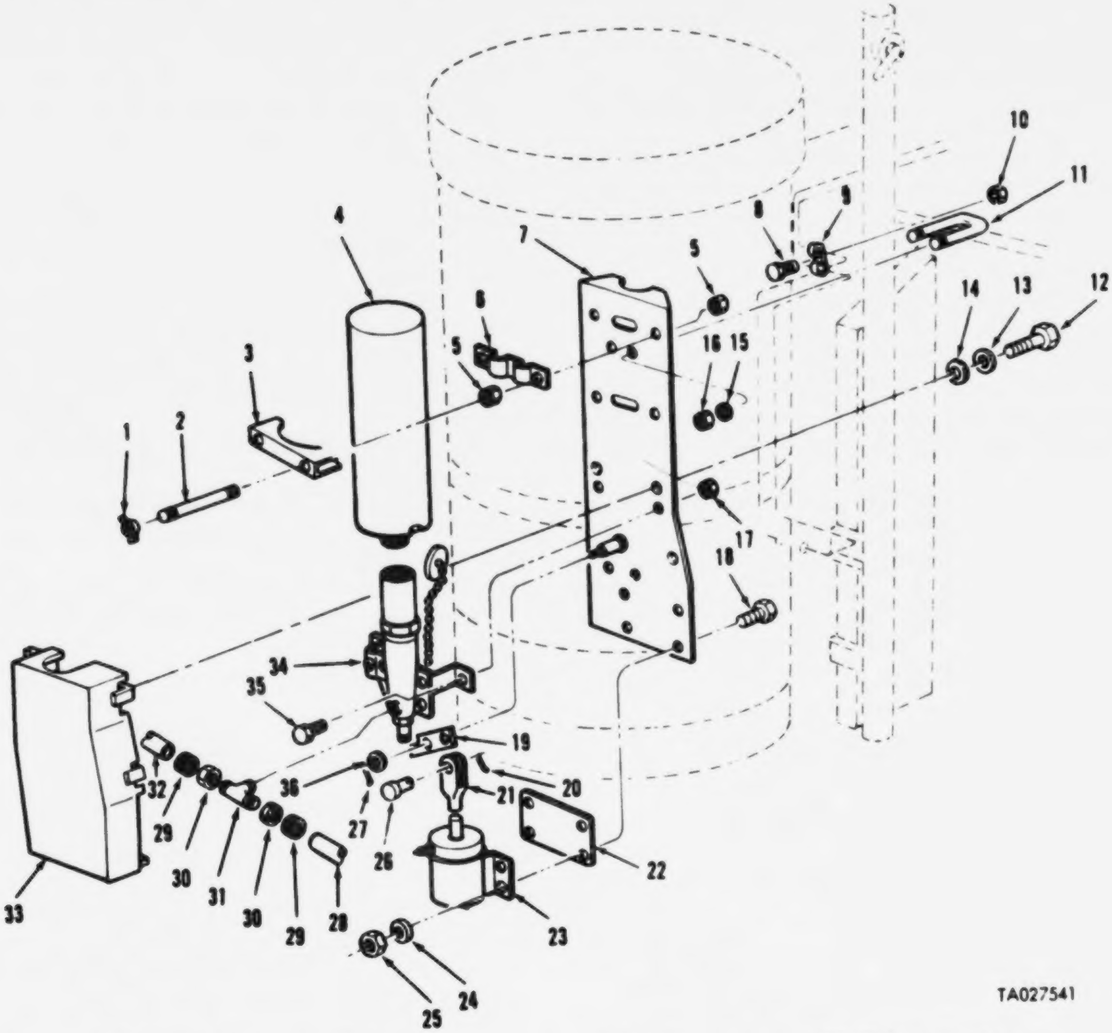
ings are pointing away from all personnel during next operation. Hold ether switch in LOAD position for 2 seconds. When switch is released, observe tube openings. If a surge of ether comes out both lines, proceed to (5) below. If a surge of ether only comes out of one line, replace other clogged line. If ether does not come out of either line, proceed to (4) below.

(4) Remove lines at the ether injector valve. DO NOT LOOK DIRECTLY INTO VALVE OPENING DURING NEXT STEP. Hold ether switch in LOAD position for 2 seconds. Release switch and observe valve opening from which tubing was removed. If a surge of ether was present, replace lines from valve to atomizers on blower manifolds. If there was no ether emitted, and it is assured that cylinder is not empty, replace ether injector valve.

(5) Remove atomizers from intake manifold (inset, fig. 2-68) and replace on tube ends. Repeat step (3) above observing orifice openings of atomizers. If ether is emitted from both of these orifices, starting problem is not in



1 Wingnut (4)
2 Stud (4)
3 Clamp (2)
4 Cylinder, ether
5 Nut (8)
6 Strap (2)
7 Bracket
8 Screw
9 Clamp (2)
10 Nut
11 U-Bolt (2)
12 Screw (3)
13 Lockwasher (3)
14 Washer (3)
15 Lockwasher (4)
16 Nut (4)
17 Locknut (2)
18 Screw (4)
19 Lever
20 Cotter pin
21 Rod end
22 Spacer
23 Solenoid
24 Washer (4)
25 Nut (4)
26 Pin
27 Cotter pin
28 Tube assembly
29 Tube nut (2)
30 Tube sleeve (2)
31 Tee
32 Tube assembly
33 Cover
34 Injector valve
35 Screw (2)
36 Washer

Figure 2-69. Removal or installation of ether kit.

ether kit. Troubleshoot engine. If ether is not emitted from one or both atomizers, replace malfunctioning atomizer(s).

b. Removal or Installation of Ether Cylinder (fig. 2-69).

(1) *Removal.* Remove four wingnuts (1) and two clamp portions (3). Unscrew ether cylinder (4) from valve (34). Screw protective cap, which is attached to valve by a chain, to valve top.

(2) *Storage.*

WARNING

Extremely flammable. Contents under pressure. Keep away from heat, sparks or open flame. Do not store at temperatures above 200ºF.

Remove and store ether cylinder indoors when ambient temperature is 70ºF or above.

(3) *Installation.* Remove four wingnuts (1) and clamps (3) from clamp studs. Unscrew cover from top of valve (34). Screw ether cylinder (4) on valve (34). Install two clamps (3) and tighten using four wingnuts (1).

c. Removal or Installation of Ether Injector Valve.

(1) *Removal.* With cylinder (4) removed (*b* above), remove three screws (12), three lockwashers (13), and three washers (14). Remove cover (33). Disconnect tube assemblies (28 and 32) at tee (31) by removing two nuts (29) and two sleeves (30). Remove tee (31) from valve. Remove two screws (35) and locknuts (17) and remove valve.

(2) *Installation.* Position ether control valve and install two screws (35) and locknuts (17). Install tee (31) in valve. Connect tube assemblies (28 and 32) at tee (31) by installing two nuts (29) and two sleeves (30). Position cover (33) and secure by installing three screws (12), three lockwashers (13), and three washers (14).

d. Removal or Installation of Ether Control Solenoid.

(1) *Removal.* Disconnect electrical connectors at solenoid (23). Remove cotter pin (20) and pin (26) securing lever (19) to rod end (21). Unscrew rod end (21) from solenoid. Remove four screws (18), washers (24), nuts (25), solenoid (23), and spacer (22).

(2) *Installation.* Position spacer (22) on solenoid (23), alining holes, and secure both to mounting bracket using four screws (18), washers (24), and nuts (25). Screw rod end (21) on extended solenoid shaft. Screw rod end (21) to a point from which lever (19) will be held just *at* valve actuating pin without depressing it. Install pin (26) and cotter pin (20) to affix lever (19) to rod end (21). Connect electrical connectors at solenoid.

e. Removal or Installation of Ether Tube Assemblies.

(1) *Removal.* Disconnect tube assemblies (28 and 32) at tee (31) by removing two nuts (29) and sleeves (30). Remove screw (8), nut (10), and clamp (9) from tube assemblies. Disconnect tube assemblies from atomizers (see inset, fig. 2-68) in blower intake manifolds. Remove tube assemblies. Remove atomizers.

(2) *Installation.* Connect tube assemblies to atomizers in blower intake manifold. Install screw (8), nut (10), and clamp (9) in tube assemblies. Connect tube asemblies (28 and 32) at tee (31) by installing two nuts (29) and sleeves (30).

f. Removal or Installation of Ether Kit Mounting Bracket.

(1) *Removal.* Remove four nuts (16) and lockwashers (15) from two U-bolts (11). Remove mounting bracket (7) from U-bolts.

(2) *Installation.* Install mounting bracket (17) to U-bolts (11) by installing four nuts (16) and lockwashers (15).

Section X. EXHAUST SYSTEM

2-47. Exhaust System

a. General. Exhaust engine gases drive the right and left side turbochargers. Exhaust gases are vented through right and left side exhaust pipe assemblies. Ends of exhaust pipes are fitted with flapper-type covers to prevent entry of foreign matter.

b. Exhaust Pipe Removal. Procedures for removal of right and left exhaust pipe assemblies are identical. To remove right sides exhaust assembly (fig. 2-70), proceed as follows:

(1) Loosen coupling (9) securing exhaust pipe to turbocharger. Slide pipe off turbocharger.

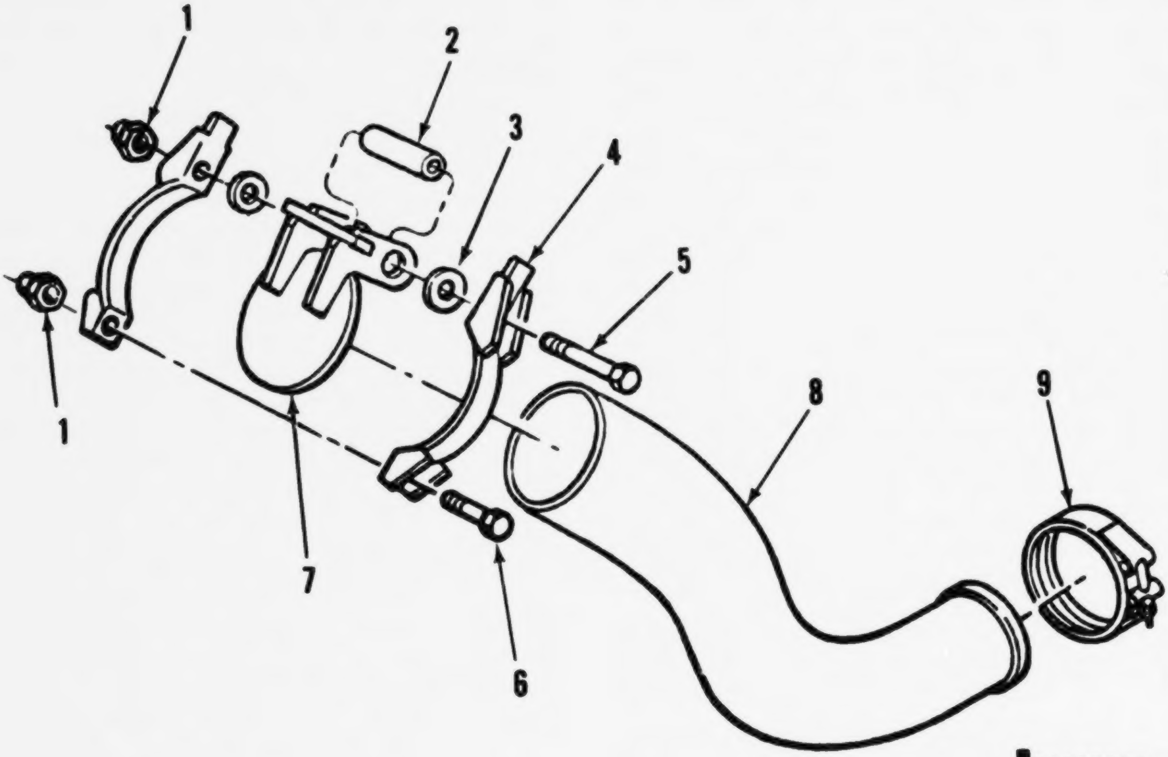
(2) Remove attached parts from exhaust pipe assembly as required.

c. Exhaust Pipe Installation.

(1) Position coupling (9) over exhaust pipe tube (8).

(2) Assemble flapper parts (1 through 7) if disassembled.

(3) Position exhaust pipe assembly and secure to turbocharger with clamp coupling (9).



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1 Nut (2)
2 Spacer
3 Washer (2)
4 Band
5 Screw
6 Screw
7 Cover
8 Tube Pipe
9 Coupling, Clamp

Figure 2-70. Installation/removal of right side exhaust pipe.

Section XI. COOLING SYSTEM

2-48. Description and Data

a. Description.

(1) *General.* The sealed-type cooling system consists of the radiator engine fan, water pump, thermostats, by-pass and crossover tubes, oil cooler housing, and a cylinder block water jacket. Coolant is drawn from the lower portion of the radiator by the water pump and is forced through the oil cooler housing and into the cylinder block. From the cylinder block, the coolant passes up through the cylinder heads and, when the engine is at normal operating temperature, through the thermostat housings and into the upper portion of the radiator. The coolant then passes down a series of tubes, where the coolant temperature is lowered by the air stream created by the revolving fan. Before the coolant reaches operating temperatures and coolant flow is prevented by closed thermostats, a bypass provides circulation within the engine.

(2) *Radiator.* The radiator consists of a core assembly, outer shell reinforcement, and support rods which secure the radiator assembly to the vehicle frame. A pre-set pressure-vacuum safety cap, installed on the filler neck, and an overflow pipe, assure a pressure tight cooling system. The radiator cap has a large pressure relief valve which seats on the filler neck inner shoulder when the cap is installed. The relief valve opens when excessive coolant pressure forces the valve spring back and coolant flows past the valve to the overflow pipe opening high on the filler neck. A smaller valve in the radiator cap assembly is held shut by spring tension against the relief valve face plate. This smaller valve is opened by atmospheric pressure when a vacuum occurs in the radiator, preventing collapse of the radiator or of radiator hoses.

(3) *Fan drive and drive belts.* The 8-bladed fan is driven by four belts connected to the crankshaft pulley. The fan drive bearings are prelubricated and require no servicing.

(4) *Water pump.* Engine coolant is drawn from the lower portion of the radiator and circulated through the oil cooler, cylinder block, and cylinder heads by the water pump. The water pump is a gear driven, centrifugal type which is mounted at the front of the engine.

(5) *Thermostats and thermostat housing.* The temperature of the coolant is controlled through the action of four blocking type thermostats, which are located in housings at the engine top front. At coolant temperatures below 170°F (approximately), the thermostats remain closed and block flow of coolant to the radiator. Valves in the thermostat housings allow coolant to flow to the pump and be recirculated within the engine. As the coolant temperature rises above 170°F (approximately), the thermostat valve closes the bypass and opens the outlet to the radiator. The thermostat will completely open when coolant temperatures reach 185°F (approximately) and will permit unrestricted circulation through the engine, engine oil cooler, and radiator.

CAUTION

Never operate engine without thermostats.

b. Data. Refer to paragraph 1-7*b*.

2-49. Servicing Coolant System

a. General. If air or exhaust gases leak into the cooling system they will cause rapid corrosion and rust formations. Corrosion and rust will eventually clog the system and cause engine overheating and loss of coolant in the radiator. Exhaust gases are sometimes blown into the cooling system past the cylinder head gasket or thorough crack(s) in the cylinder head or block assemblies.

WARNING

When engine has been operating, remove radiator cap slowly to relieve pressure and to avoid injury to personnel.

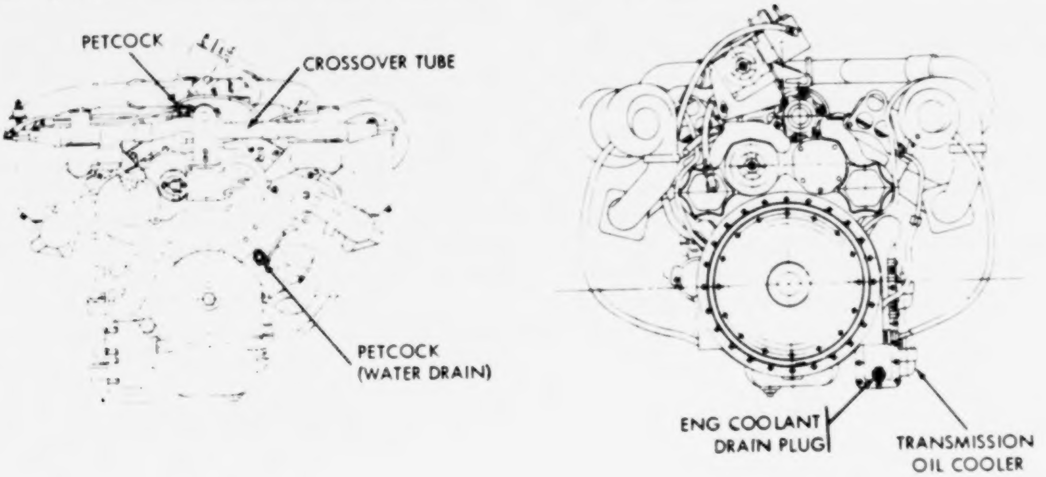
b. Air Leak Test. Bring level of coolant to overflow tube inlet of radiator. Drain out three pints of coolant to prevent overflowing during test. Be sure radiator cap is in good condition and will make an airtight seal. Attach length of rubber tubing to end of overflow tube. This connection must be airtight. Run engine until temperature gage stops rising and remains stationary. Without changing engine speed, put end of rubber tube in bottle of water. Be sure there are no kinks or bends in tube to restrict airflow. Watch for bubbles in water. Bubbles indicate air is entering the cooling system. Correct condition by tightening water pump cover bolts, hose fittings, clamps, and all fittings. Replace hose if cracked, swollen or deteriorated.

c. Preventive Cleaning. In order to efficiently clean the cooling system of rust, scale, or sludge, use a cleaner, followed by a neutralizer to stop action of cleaner. Neutralizing and flushing after neutralization are very important, as the cleaner contains a strong acid which, if not completely removed, will attack the parts of the cooling system. Also, precautions should be taken not to spill any cleaning compound on skin, clothing, or vehicle paint.

CAUTION

Do not pour cold water or coolant liquid into cooling system when engine temperature is above 200°F. Also, cold water or coolant liquid poured into cooling system regardless of engine temperature, will close thermostats and not allow engine water jackets and passages to completely fill. After adding cold water or coolant liquid to system, always run engine until normal operating temperature is reached (thermostats open), then add water or coolant liquid until coolant reaches proper coolant level.

(1) *Drain system.* Run engine at fast idle until normal engine temperture (at least 185° F) is reached and then stop engine. Remove radiator cap, open radiator drain cock (66, fig. 2-72), and cylinder block drain cocks (fig. 2-71) and allow cooling system to drain.



FRONT VIEW

REAR VIEW

Fig. 2-71. Engine coolant drain locations.

(2) *Clean system.* Close radiator and cylinder block drain cocks. Place a clean container under overflow tube to catch any overflow, which may be needed to maintain proper level in the radiator. Be sure temperature of engine is below 200° F. Pour cleaning compound (one container to every four gallons of cooling system capacity) into radiator, then fill system with water. Install pressure-type cap on radiator. Start engine and run it at fast idle to heat solution to at least 185°F. Use a cardboard to cover radiator if necessary, but do not allow coolant to boil. Continue to run engine at least 30 minutes. Stop engine, remove radiator cap, open radiator and engine block drain cocks, and allow system to drain completely. Refer to TB 750-651.

(3) *Neutralize system.* Close radiator and crankcase drain cocks. Pour neutralizer (one container to every four gallons of cooling system capacity) into radiator, then fill system with water and install radiator cap. Start engine and run it at a fast idle, using radiator cover as necessary, to heat solution to at least 185°F. Continue to run engine at least 10 minutes. Stop engine, remove radiator cap, open radiator and engine cylinder block drain cocks, and allow system to drain completely.

(4) *Flush system.* Close radiator and engine block drain cocks. Fill system with clean fresh water (soft if possible) then install radiator cap. Start engine and run it at a fast idle, using radiator cover as necessary, to bring operating temperature to at least 185°F. Continue to run engine for at least 5 minutes. Remove radiator cap, open radiator and engine block drain cocks, and allow system to drain. If water is discolored to any extent, repeat this flushing operation.

CAUTION

Do not flush system by inserting a hose in radiator with the engine running and the drain cocks open. This procedure will close thermostats and stop circulation of coolant through the engine.

(5) *Clean radiator, cap, overflow tube, and drain cocks.* Clean cap by spraying a stream of water (hot if possible) through the holes in the valve cage while moving the pressure valve up and down with a blunt wooden instrument or a pencil. Clean out overflow pipe with a stream of water. Clean out dirt, trash, and insects embedded in the air passages of the radiator, using compressed air or a low pressure stream of water but do not use steam.

CAUTION

Do not hold air or water hose too close to the radiator or use too great pressure as damage to radiator may result. Clean out any stoppage in drain cocks with a soft wire.

(6) *Fill system.* Close radiator and engine block drain cocks; then slowly fill system to suit climatic conditions as follows: if above 32°F, partially fill the system with clean fresh water or coolant liquid (if available), and add a corrosion inhibitor; then fill with water until coolant level is visible in filler neck. If there is a possibility that temperature below 32°F will be encountered, fill system with equal parts of water and ethylene glycol. For expected temperatures below minus 40°F, fill radiator with arc-

tic type antifreeze solution MIL-C-11755 undiluted. Allow time for trapped air to escape and to assure that maximum amount of coolant has been added to the system. Install radiator cap, start engine, and run at a fast idle until temperature gage shows normal operating temperature; then stop engine and check coolant level, adding coolant as necessary.

(7) *Rust preventives.* The cooling system must be free of rust and scale to maintain efficiency of the system. Use of inhibitors or rust preventives reduces or prevents formation of scale. Inhibitors are not cleaners and do not remove rust or scale already formed. Treating the cooling system with an inhibitor consists of adding an inhibitor to the coolant. The inhibitor should be renewed periodically, and especially if the system has been cleaned or flushed.

2-50. Radiator

Fig. 2-72

a. Removal.

(1) Drain cooling system (para 2-49*c*(1)).

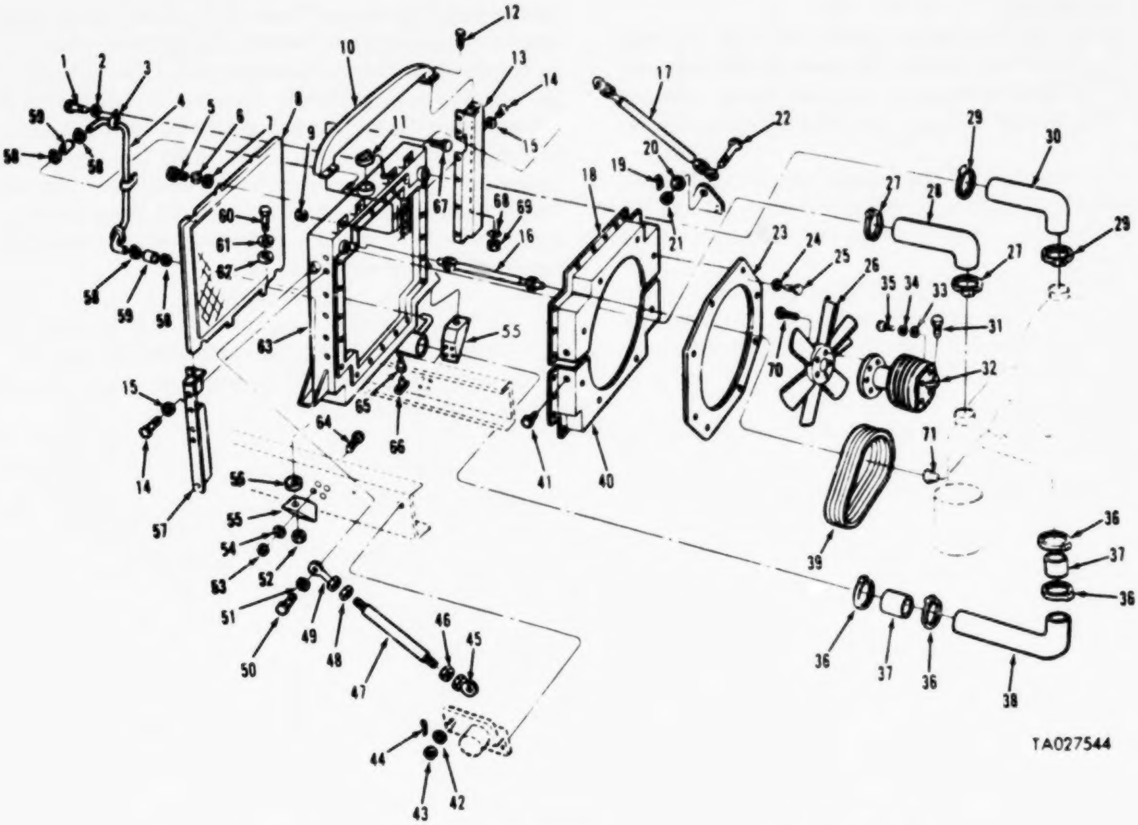
(2) Remove ring (23). Remove upper and lower parts of split fan shroud (18 and 40). Shroud parts are secured to each other by four screws (41). Lower shroud half may be left on vehicle.

(3) Loosen two clamps (27 and 29) on inlet hoses (28 and 30) at top of radiator and pull hoses from radiator. Loosen two clamps (36) on hose (37) of outlet tube (38) at bottom of radiator and remove hose from radiator. Disconnect small i.d. hose (16) from radiator.

(4) Disconnect radiator support tubes (17 and 47) at frame brackets. Remove screw (50) and washer (51) securing each support rod to radiator. Remove support rods.

(5) Disconnect radiator (63) from mounting brackets (55) by removing screw (60), washer (61), and mount (62) from each side of radiator.

(6) Remove radiator (63), shroud (10), side shrouds (13 and 52), tube (4), and radiator guard (8).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1 Screw (3)
2 Lockwasher (3)
3 Clamp (3)
4 Tube
5 Screw (7)
6 Lockwasher (7)
7 Washer (7)
8 Guard
9 Nut (6)
10 Shroud
11 Cap
12 Screw (2)
13 Shroud, side (R.H.)
14 Screw (12)
15 Lockwasher (12)
16 Hose
17 Tube assembly (2)
18 Shroud, upper
19 Cotter Pin
20 Lockwasher
21 Nut
22. Screw
23 Ring
24 Lockwasher (8)
25 Screw (8)
26 Fan
27 Clamp (2)
28 Hose
29 Clamp (2)
30 Hose
31 Adjusting screw
32 Fan drive
33 Washer (4)
34 Lockwasher (4)
35 Screw (4)
36 Clamp (4)
37 Hose (2)
38 Tube
39 Fan belt (set of 4)
40 Shroud, lower
41 Screw (4)
42 Lockwasher
43 Nut
44 Cotter pin
45 Rod end (2)
46 Nut (2)
47 Tube (2)
48 Nut (2)
49 Rod end (2)
50 Screw (2)
51 Lockwasher (2)
52 Nut (2)
53 Nut (8)
54 Washer (8)
55 Bracket (2)
56 Mount (2)
57 Shroud, side (L.H.)
58 Clamp, hose (4)
59 Hose (2)
60 Screw (2)
61 Washer (2)
62 Mount (2)
63 Radiator assembly
64 Screw (8)
65 Bushing
66 Drain cock
67 Screw (6)
68 Lockwasher (6)
69 Nut (6)
70 Screw (6)
71 Adapter

Figure 2-72. Cooling system, radiator area—exploded view.

b. Installation.

(1) Position radiator guard (8), tube (4), side shrouds (13 and 50), shroud (10), radiator (63) and connect radiator (63) to mounting brackets (55) by installing screw (60), washer (61) and mount (62) to each side of radiator.

(2) Assemble radiator support tubes (17 and 47) on radiator (63). Secure radiator support tubes (17 and 47) by installing screw (50) and washer (51). Connect tubes to frame bracket.

(3) Connect small hose (16) to radiator. Tighten two clamps (36) on hose (37) of outlet tube (38) at bottom of radiator and install hose to radiator. Tighten two clamps (27 and 29) on outlet hoses (28 and 30) at top of radiator and insert hoses to radiator.

(4) Install upper and lower parts of split shroud (18 and 40). Install ring (23).

(5) Refill cooling system (paragraph 2-49*c(6)).*

2-51. Fan

NOTE

Items called by number in this paragraph refer to figure 2-72.

a. Removal.

(1) Unless already removed, remove upper shroud (18) and ring (23).

(2) Secure fan with rope or other suitable material to prevent damage during removal.

(3) Remove six screws (70) holding fan (26) to fan drive (32). Remove fan.

b. Installation.

(1) Secure fan (26) with rope or other suitable material to prevent damage during installation.

(2) Position fan to fan drive (32). Align fan to fan drive.

(3) Install six screws (23).

(4) Install upper shroud (18) and ring (23) if removed during removal operation.

2-52. Fan Belts

NOTE

Unless belts have had fewer than four hours of operation, replace all four belts at once.

a. Removal (fig. 2-72). Remove fan (para 2-51*a*). Loosen four screws (35) so that fan drive (32) slips downward in screw slots. Remove belts (39). At this point, inspect pulleys for tightness and alinement. Inspect pulleys for nicks or sharp edges that could damage belts.

b. Installation. Install belts (39). Position fan drive (32) and tighten four screws (35). Adjust belt tension (*c.* below) and install fan, fan shroud half, and upper ring.

c. Adjustment (fig. 2-73). With upper portions of fan shroud and ring removed, loosen four screws securing fan drive to engine bracket. Fan drive flange holes are slotted to permit up or down adjustment of fan drive. Apply 12 lbs of force perpendicularly at center of belt span and measure belt deflection. Belt deflection should be approximately 5/32 inch (fig. 2-73). Move fan drive up or down and tighten fan drive mounting screws when correct tension is achieved. Fan drive will move down by tightening adjusting screw, and will move up by applying crow bar upward under fan drive.

CAUTION

All belts must have the same tension. If belts do not have the same tension, replace the whole set. A new belt set should be rechecked after two days of operation.

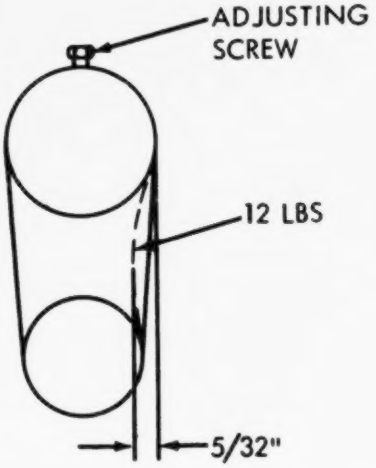

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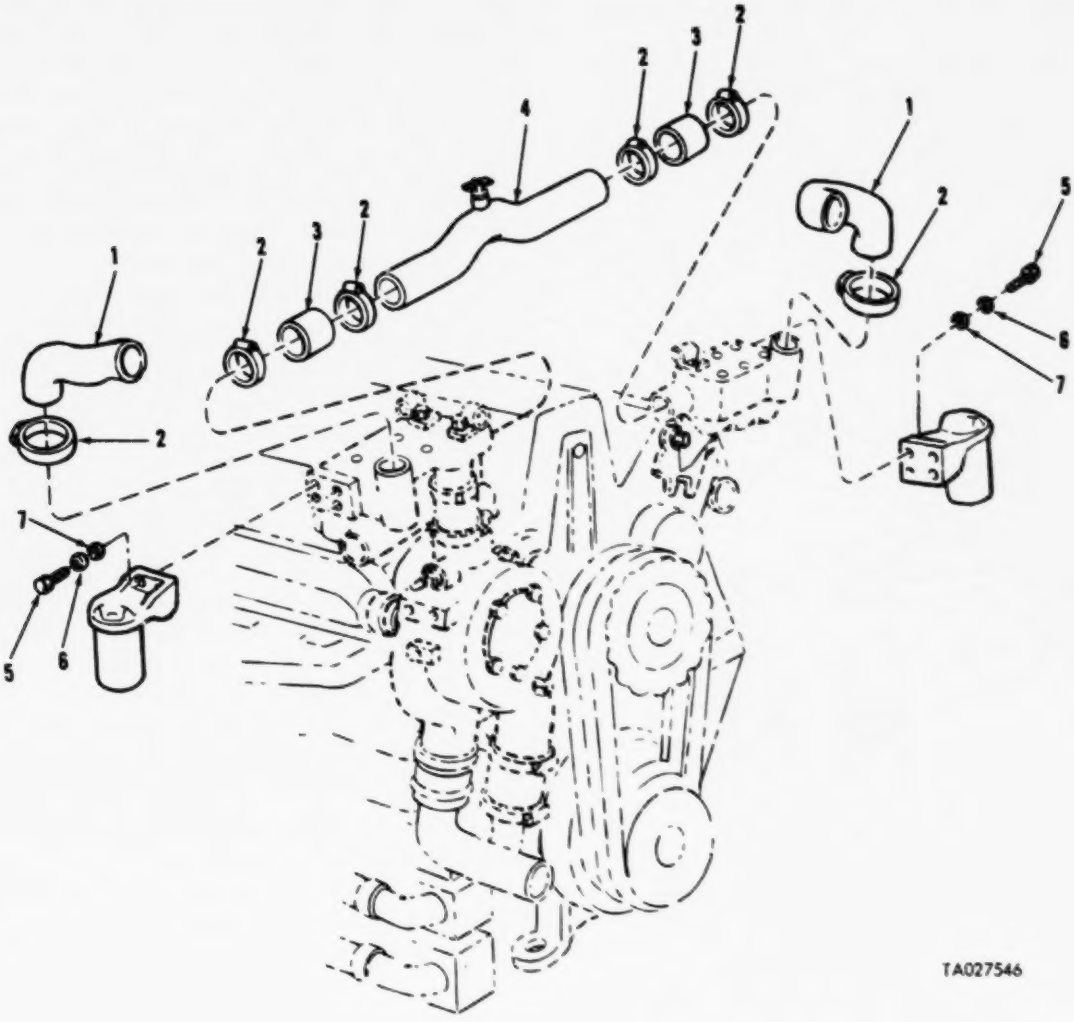
Figure 2-73. Checking and adjusting fan belt tension.

2-53. Radiator Hoses

Fig. 2-72

Replace radiator hoses (28, 30) and tube (38) as required. Drain coolant from system (paragraph 2-49*c*(1)). Loosen clamps at hose ends and remove hoses and/or tube. Disconnect hose (16) at radiator and at engine hose adapter and remove hose. Install by connecting hose (16) at radiator and at engine hose adapter. Tighten clamps at hose ends to secure hoses and/or tube. Supply coolant to system (para 2-49). Start engine and check for leaks.



1 Hose (2)
2 Clamp, hose (6)
3 Hose (2)
4 Crossover tube
5 Screw (8)
6 Lockwasher (8)
7 Washer (8)

Figure 2-74. Cooling system water pump area—exploded view.

2-54. Thermostat Replacement

a. Removal.

(1) Drain cooling system to necessary level.

(2) Disconnect fuel lines at secondary fuel filter (fig. 2-56) and disconnect fuel pressure switch electrical leads (right side only).

(3) Remove four screws (5, fig. 2-74), washers (7), and lockwashers (6) retaining fuel filter to right bank thermostat housing cover.

(4) Loosen clamps (2), disconnect hose (1, 3), and crossover tube (4).

(4) Remove six screws (fig. 2-75) securing thermo-

stat housing cover to thermostat housing, and remove cover.

(6) Remove thermostats. Remove and discard thermostat cover gasket and thermostat seals.

(7) To replace thermostats in left bank, remove fuel lines at strainer and remove fuel strainer. Proceed as in sub-paragraphs (4), (5), and (6) above.

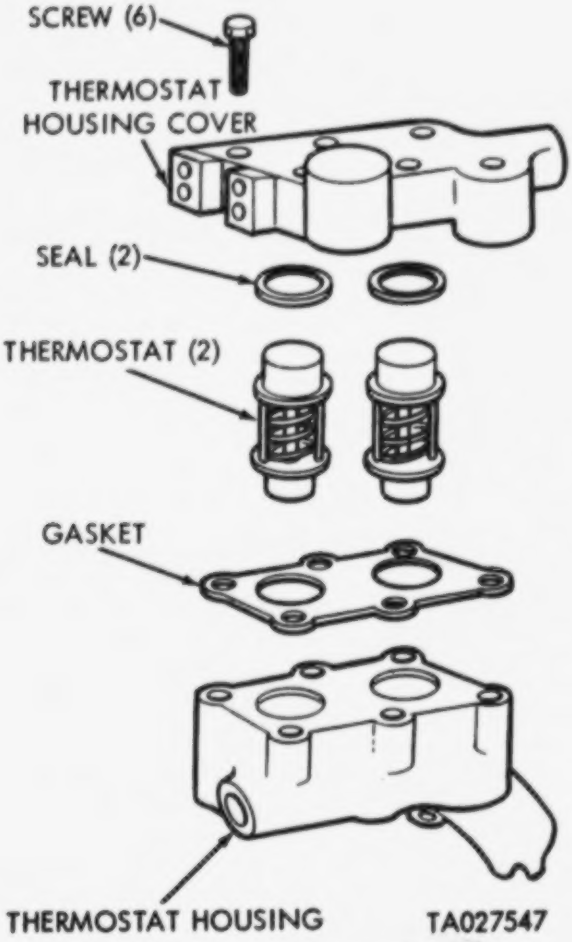


Figure 2-75. Thermostat housing—exploded view.

b. Testing. A defective thermostat which remains closed, or only partially open, will restrict the flow of coolant and cause the engine to overheat. A thermostat which is stuck in a full open position may not permit the engine to reach its normal operating temperature. The incomplete combustion of fuel due to cold engine operation will result in excessive carbon deposits on the pistons, rings, and valves. Properly operating thermostats are essential for efficient operation of the engine. If the engine operating temperature deviates from the normal range of 160° to 185° F, the thermostats must be removed and checked. The operation of a thermostat may be checked by immersing it in a container of hot water. Place suitable thermometer in the container, but do not allow it to touch the bottom of the container. Agitate the water to maintain an even temperature throughout the container. As the water is heated, the thermostat should begin to open when the water temperature is approximately 165° or 179° F (the opening temperature is usually stamped on the thermostat). The thermostat should be fully open at approximately 180° or 185°F depending upon type thermostat used.

c. Installation (figs. 2-74 and 2-75).

(1) Install new seal(s) in the thermostat housing cover(s) (fig. 2-75) using installer J-8550 and driver handle J-7079-2 (fig.2-76 and table 2-2). Position seal so that lip of seal faces up (away from thermostat) when cover is installed on thermostat housing. The seal installing tool assures that seal is positioned the correct distance from bottom face of the cover and parallel with cover face.

(2) Place new gasket(s) on thermostat housing (s).

(3) Set thermostat(s) in thermostat housing(s).

(4) Attach the covers to the thermostat housings with bolts and lockwashers. Torque bolts between 30 and 35 lb.-ft.

(5) Install fuel lines at fuel filter and connect fuel pressure switch electrical leads.

(6) Attach fuel filter or strainer by installing four screws, washers, and lockwashers.

(7) Install by-pass (crossover) tube and radiator hose. Tighten hose clamps.

(8) Close drain cocks in cylinder block. Then fill cooling system.

(9) Start engine and check for leaks.

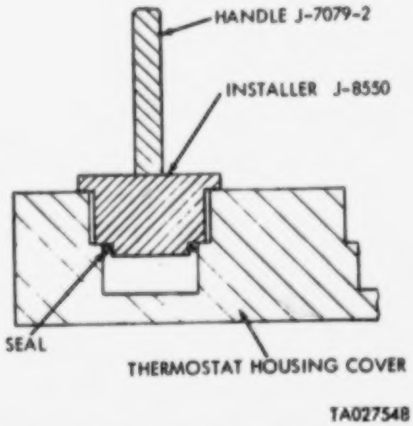


Figure 2-76. Using installer and handle to seat thermostat seal.

Section XII. ENGINE ELECTRICAL SYSTEM

2-55. General

The engine electrical system consists of the starter, starter relay, alternator, various transmitters, solenoids, switches, and electrical cable connections to operate the components. In addition, two electrical disconnect panels are provided; one at the left center, and one at the right front of the engine to facilitate connecting and disconnecting the engine electrical components.

WARNING

Prior to replacing any electrical components, be sure electrical current has been disconnected.

2-56. Alternator

Fig. 2-77

a. Removal.

(1) Disconnect engine wiring ground cable and harness from alternator connector.

(2) Remove screw, two washers, and nuts securing one end of adjustment link

(3) Remove screw, two washers, and nut securing other end of adjustment link and remove link.

(4) Attach lifting sling to alternator housing mounting bracket.

(5) Loosen two screws, washers, and nuts securing alternator to mounting bracket. Move alternator towards engine block and lift off two drive belts from alternator drive pulley.

(6) Remove nut, flat washer, and woodruff key from alternator drive shaft and use puller to remove pulley from alternator.

(7) Remove alternator from mounting bracket.

(8) Remove two nuts securing shield to engine and remove shield.

(9) Remove four screws and lockwashers securing mounting bracket.

b. Installation.

(1) Position mounting bracket on engine and secure mounting bracket with four screws and lockwashers.

(2) Position shield on engine and secure shield with two nuts.

(3) Place alternator on mounting bracket. Place drive pulley on alternator drive shaft and secure pulley by installing nut, flatwasher, and woodruff key.

(4) Assure alignment of alternator drive pulley to main drive pulley on engine. Place two drive belts on alternator drive pulley. Refer to *c* below for checking and adjusting alternator tension.

(5) Remove lifting sling on alternator housing mounting bracket.

(6) Position adjustment link and secure one end with screw, two washers, and nut. Secure other end of adjustment link in same manner.

(7) Connect engine wiring ground cable and harness to alternator connector.

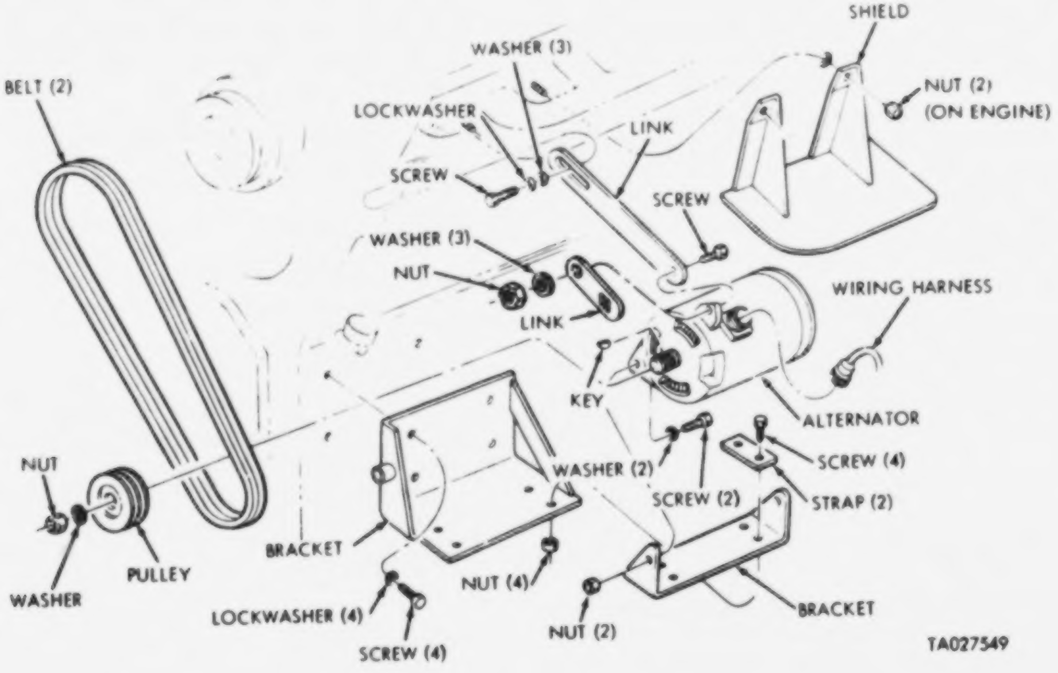


Figure 2-77. Removal or installation of alternator.

c. Checking and Adjusting Alternator Belt Tension (Fig. 2-78). Apply a 12-lb side load to center of belt span on each belt and measure belt deflection. Deflection should not be more than ⅝ inch. To adjust, loosen screw securing link to engine block. Attach ratchet wrench extension into alternator adjustment link opening and pull down on wrench to pry alternator outward. Tighten link screw when desired belt tension is achieved.

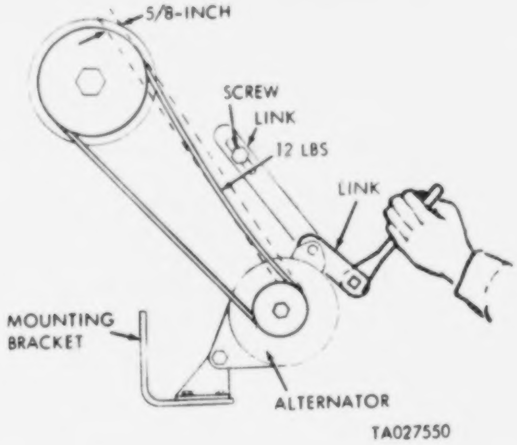


Figure 2-78. Checking and adjusting alternator belt tension.

2-57. Starter Motor Assembly

Fig. 2-79

a. Removal.

(1) Open left engine access door and remove nut and lockwasher securing battery negative cable and solenoid ground lead to terminal post on starter motor end plate. Remove cables and lead from post.

(2) Remove nut and lockwasher securing positive cable and harness lead cable to large terminal post on solenoid.

(3) Remove screw and lockwasher securing relay lead to solenoid.

(4) Remove three screws and lockwashers securing starter assembly to engine flywheel housing.

(5) Use jack or other means to support starter while pulling out of flywheel housing.

(6) Remove starter assembly and discard gasket.

b. Installation. Use new gasket when installing starter motors.

(1) Use jack or other means to support starter while installing starter in flywheel housing.

(2) Position starter assembly to engine flywheel housing and secure with three screws and lockwashers.

(3) Position relay lead to solenoid and secure with screw and lockwasher.

(4) Position positive cable and harness lead cable to large terminal post on solenoid and secure with nut and lockwasher.

(5) Position battery negative cable and solenoid ground lead to terminal post on starter motor end plate and secure with nut and lockwasher.

2-58. Voltage Regulator

Fig. 2-80

a. Removal. Disconnect two harness connectors at five lockwashers securing regulator and flood light ground lead to mounting bracket. Remove voltage regulator.

b. Installation. Position voltage regulator and flood light ground lead on mounting bracket and secure with four nuts, screws, washers, and five lockwashers. Connect two harness connectors to voltage regulator.

c. Adjustment. Refer to troubleshooting table 2-29, malfunction 2, step 1.

2-59. Power Take-Off Solenoid

Refer to paragraph 2-102.

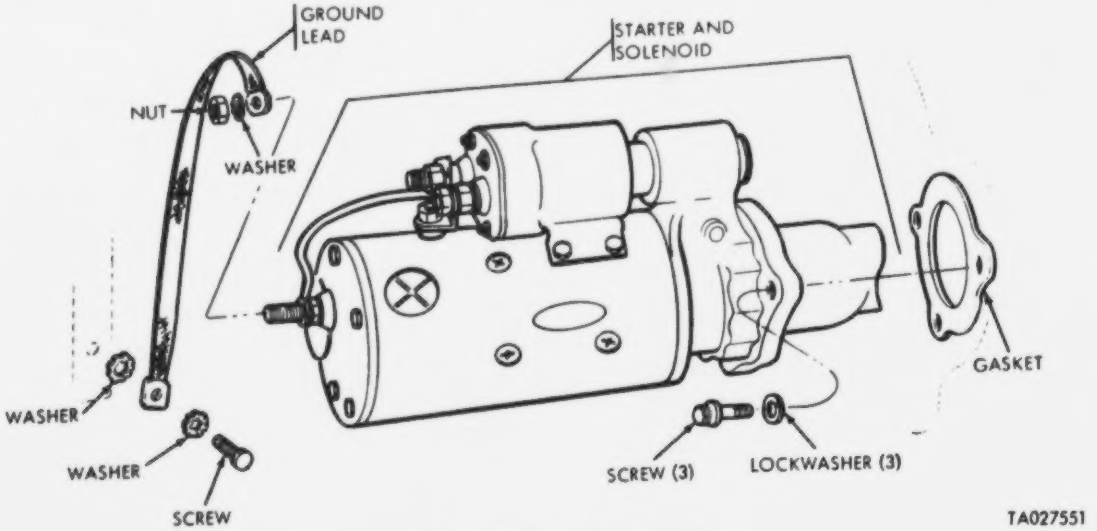


Figure 2-79. Starter motor assembly.

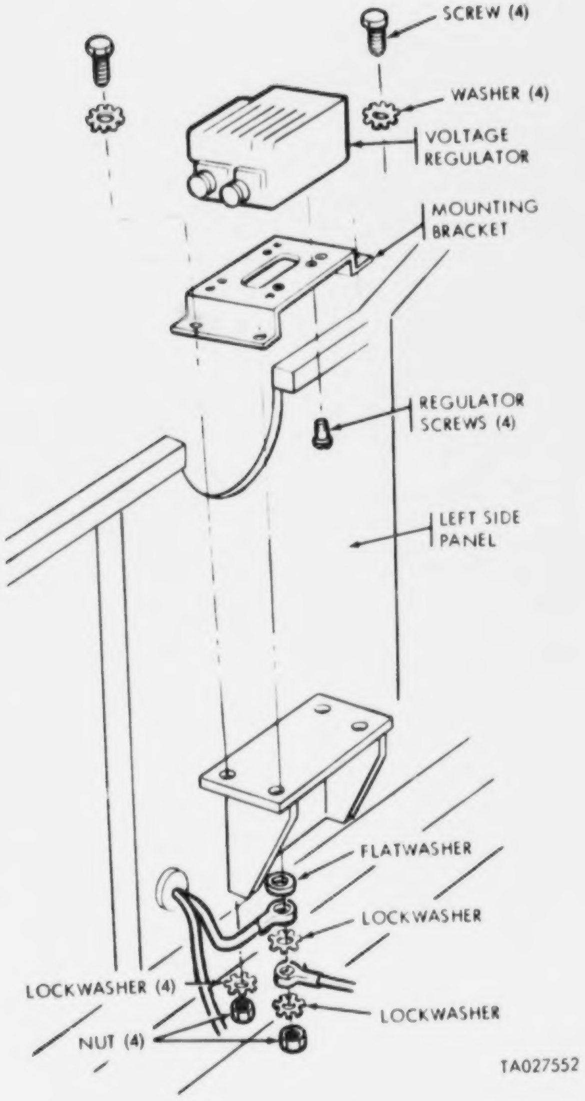


Figure 2-80. Removal or installation of voltage regulator.

2-60. Fuel Pressure Switch

a. Removal. Disconnect electrical leads at switch and unscrew switch from filter assembly (fig. 2-56).

b. Installation. Screw switch into filter assembly and connect electrical leads.

2-61. Sending Units and Transmitters

Fig. 2-81

The power plant sending units and transmitters are similar in installation and removal. Disconnect electrical connector(s) and unscrew unit from power plant. Refer to figure 2-81 for identification and location of sending units and transmitters.

2-62. Fuel Level Transmitter

a. Removal (fig. 2-59). Remove three screws and lockwashers securing plate to fuel tank. Remove lockwire and five screws from fuel level transmitter. Carefully pull transmitter up out of tank, altering direction of pull to allow safe removal of transmitter fuel level float. Remove flat gasket and discard.

b. Installation. Place new gasket on fuel tank. Insert fuel level transmitter through gasket into tank, taking care to avoid damage to fuel level flat. Install five screws and safety wire. Install cover plate, three screws, and lockwashers.

2-63. Fuel Shutoff Solenoid

Fig. 2-82

a. Removal.

(1) Disconnect two electrical connectors from fuel shutoff solenoid.

(2) Remove two nuts securing solenoid shaft to link.

(3) Remove four screws securing solenoid and remove solenoid.

b. Installation.

(1) Position solenoid and secure with four screws.

(2) Attach solenoid shaft to link with two nuts.

(3) Connect two electrical connectors to fuel shutoff solenoid. Assure that solenoid actuator stem is secured to link while lever is in idle position and pivoted to its right hand extremity.

2-64. Starter Relay and Disconnect Brackets

Figs. 2-83 and 2-84

a. Replace Starter Relay (Fig. 2-83). Disconnect electrical connector. Remove two nuts, screws, and three lockwashers securing relay and ground cable to disconnect bracket. Remove relay.

b. Installation of Relay. Secure relay and ground cable to bracket with two nuts, screws, and three washers. Connect electrical connectors.

c. Replace Left Disconnect Bracket. Disconnect five electrical harnesses at disconnect bracket. Remove screws, nuts, and lockwashers securing five receptacles to bracket and remove receptacles. Remove starter relay (*a* above). Remove four screws and lockwashers securing left disconnect bracket to engine. Remove bracket.

d. Installation of Bracket. Secure bracket to engine with four screws and lockwashers. Replace starter relay (*b* above). Secure five receptacles to bracket with screws, nuts, and lockwashers. Connect five electrical harnesses at disconnect bracket.

e. Removal and Installation of Right Disconnect Bracket (fig. 2-84). Disconnect two electrical harnesses at bracket. Remove eight screws, nuts, and lockwashers securing two receptacles to bracket. Remove three screws and lockwashers securing bracket to water pump. Remove bracket. Position bracket to water pump and se-

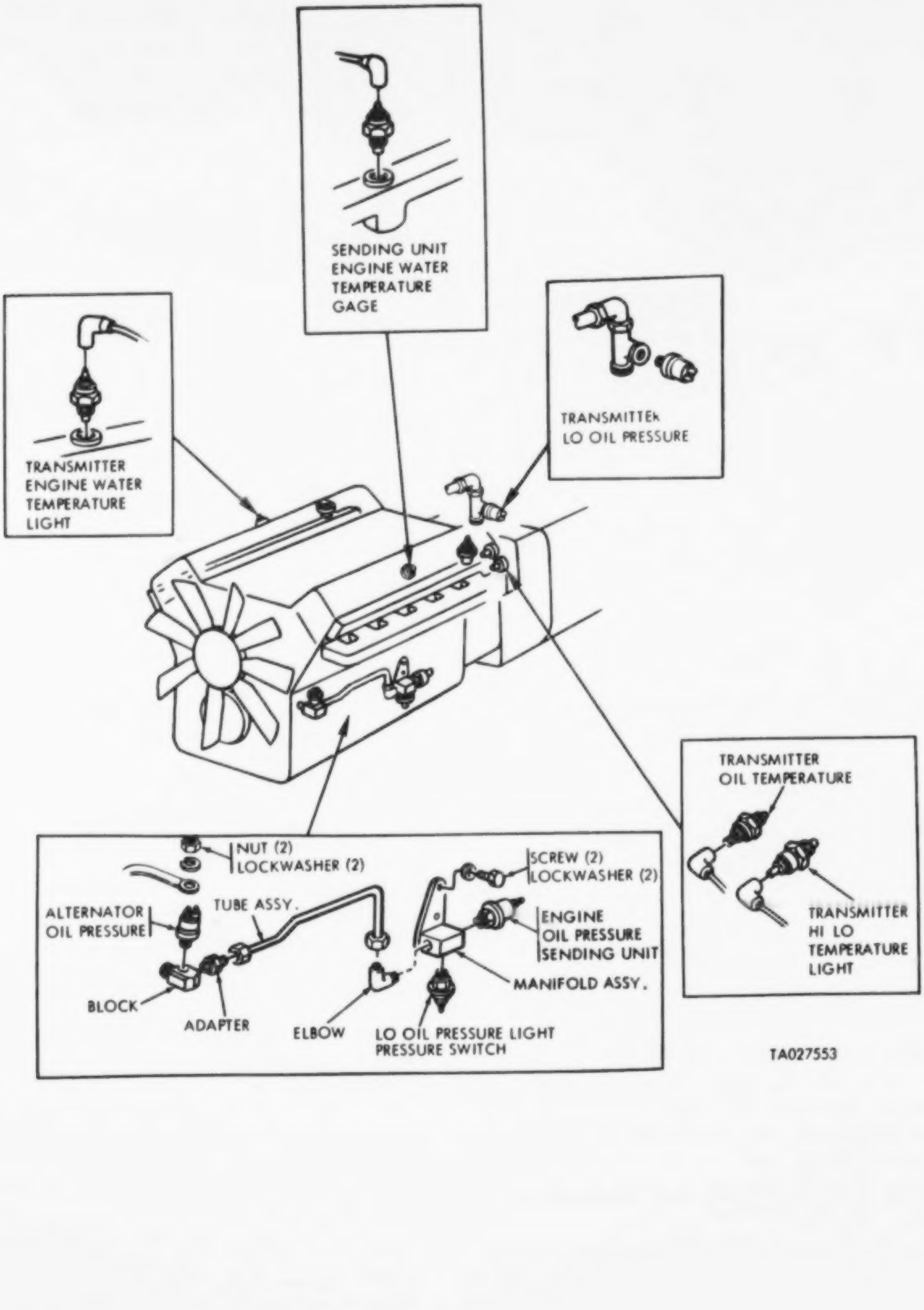

SENDING UNIT
ENGINE WATER
TEMPERATURE
GAGE
TRANSMITTER
ENGINE WATER
TEMPERATURE
LIGHT
TRANSMITTER
LO OIL PRESSURE
TRANSMITTER
OIL TEMPERATURE
TRANSMITTER
HI LO
TEMPERATURE
LIGHT
NUT (2)
LOCKWASHER (2)
ALTERNATOR
OIL PRESSURE
TUBE ASSY.
SCREW (2)
LOCKWASHER (2)
ENGINE
OIL PRESSURE
SENDING UNIT
MANIFOLD ASSY.
BLOCK
ADAPTER
ELBOW
LO OIL PRESSURE LIGHT
PRESSURE SWITCH
TA027553

Figure 2-81. Sending units and transmitters.

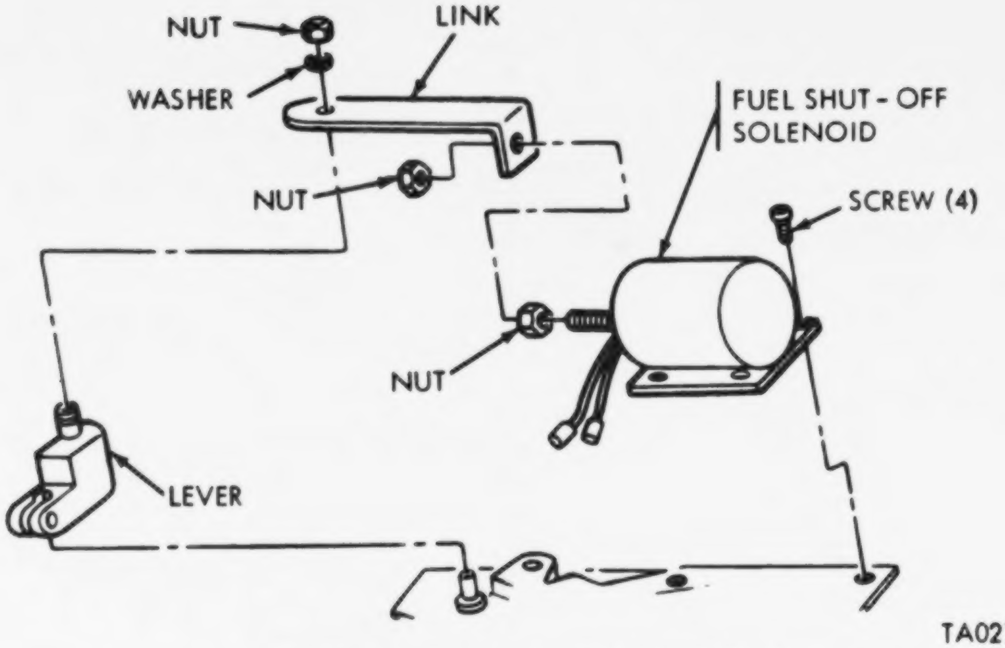


Figure 2-82. Removal or installation of fuel shutoff solenoid.

cure by installing three screws and lockwashers. Install eight screws, nuts, and lockwashers to secure two receptacles to brackets. Connect two electrical harnesses to bracket.

2-65. Vehicle Wiring Harnesses, Cables, and Receptacles

a. General.

(1) This section contains replacement or repair procedures for the vehicle wiring harnesses, cables, and receptacles.

(2) Repair cables and harnesses whenever possible. Replacement of cables and harnesses shall be limited to assemblies beyond repair or to special fabricated assemblies not having replacement parts. Repair crimped or soldered terminal connections. When soldering electrical connections, use rosin-core solder only.

(3) Refer to electrical system wiring diagrms (FO-1 and FO-2) to determine electrical lead circuit number corresponding to identification band on electrical lead. Refer to electrical troubleshooting (para 2-22) for testing and test equipment.

(4) Plugs and connectors are standard items. Refer to figures 2-85 through 2-87 for general guidelines for repair.

b. Description. The vehicle wiring harnesses are made up of cables, connectors, plugs, receptacles, and terminals required to carry power to the vehicle electrical components. Harnesses are secured to the vehicle by clamps and terminate in the connector plugs, connector receptacles, or the cable terminals. All connectors are protected by rubber gaskets or grommets to assure waterproof connections. Trailer electrical coupling receptacles are provided for connecting electric power to fifth wheel towed and pintle-towed trailers.

c. Wiring Harness Repair.

NOTE

All harness terminals and separate cables or leads have metal tags that identify the circuit numbers.

Refer to figures 2-85 through 2-87 for general harness repair and to TBORD 650 for specific repair. In addition, the methods listed below may be used for simple repairs.

(1) Remove all loose outer covering and clean conduit and remaining covering with rubber solvent and wipe dry.

(2) Wrap cable with insulating tape from end to end making sure to have a lap joint one-half the width of the tape. Tie the loose end of tape at the connector.

(3) Resolder any wires that have broken or pulled off connector terminals.

(4) Clean corrosion from pin terminal and pin socket connector fittings with sandpaper or crocus cloth.

(5) Connect loose connectors and inspect rubber grommets. Replace grommet if required.

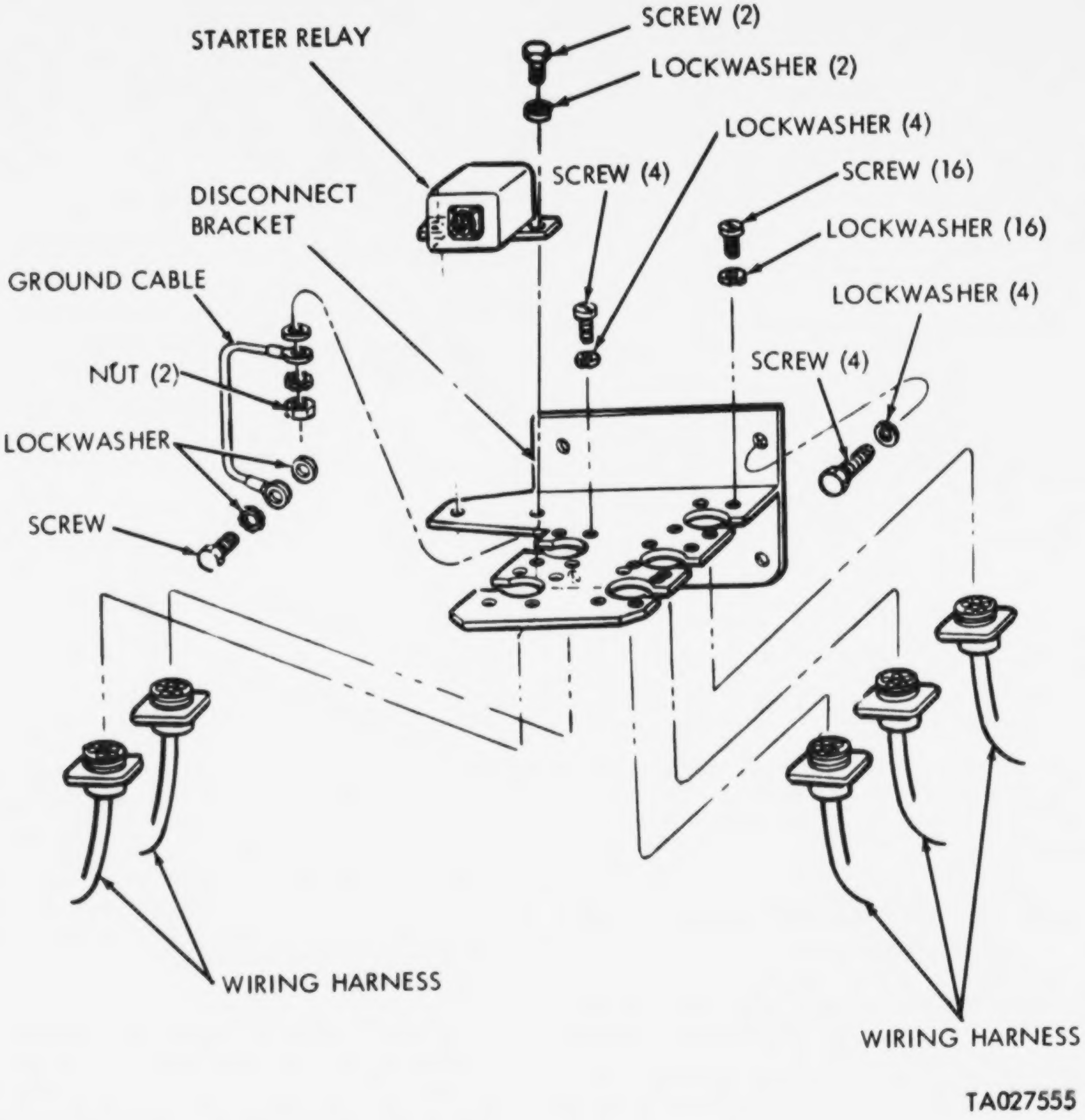

SCREW (2)
STARTER RELAY
LOCKWASHER (2)
LOCKWASHER (4)
SCREW (4)
SCREW (16)
DISCONNECT BRACKET
LOCKWASHER (16)
GROUND CABLE
LOCKWASHER (4)
SCREW (4)
NUT (2)
LOCKWASHER
SCREW
WIRING HARNESS
WIRING HARNESS
TA027555

Figure 2-83. Starter relay and left disconnect brackets.

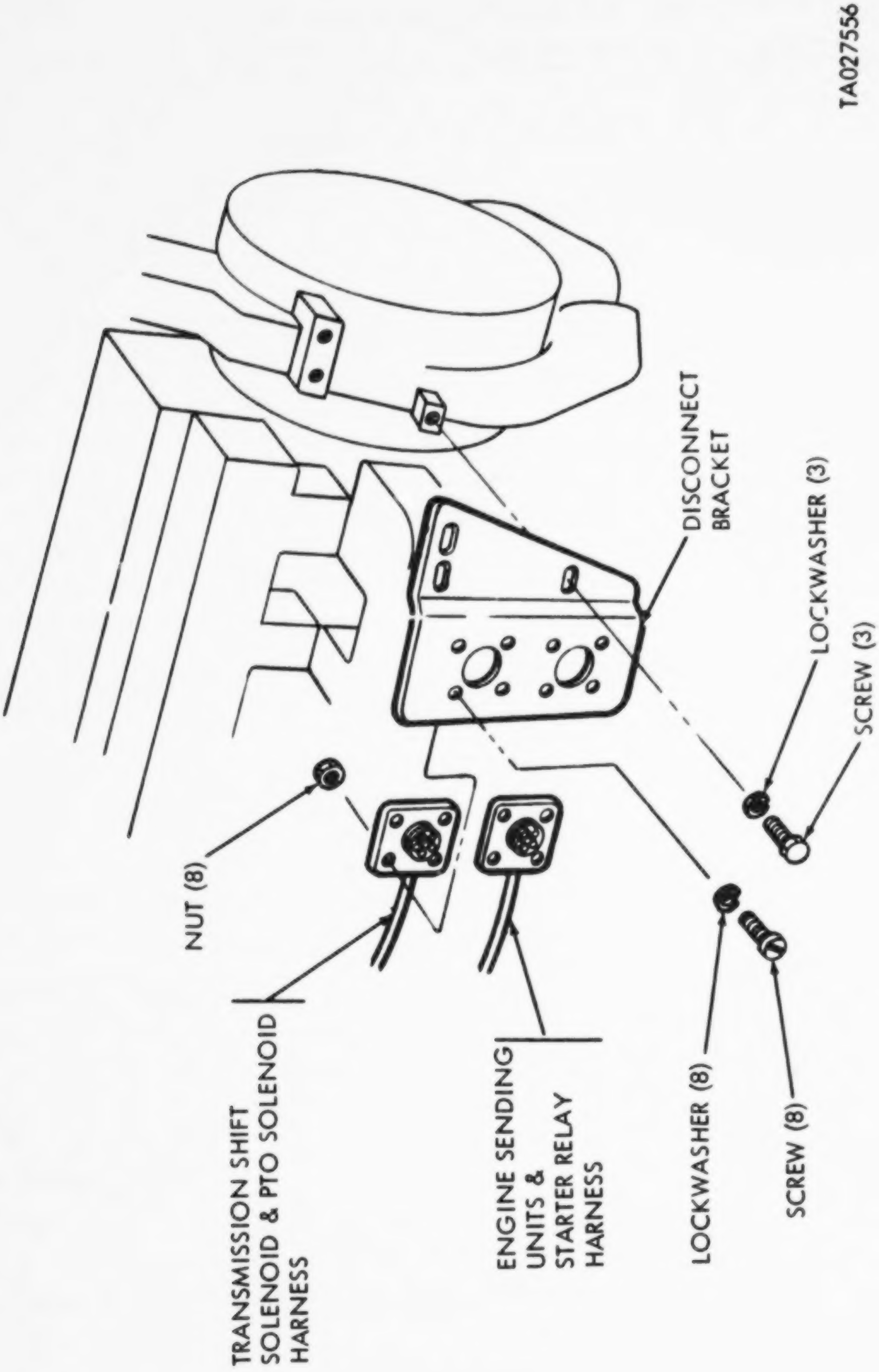
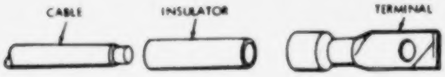
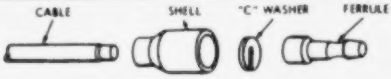

TA027556
DISCONNECT BRACKET
LOCKWASHER (3)
SCREW (3)
NUT (8)
TRANSMISSION SHIFT SOLENOID & PTO SOLENOID HARNESS
ENGINE SENDING UNITS & STARTER RELAY HARNESS
LOCKWASHER (8)
SCREW (8)

Figure 2-84. Engine right electrical disconnect bracket.


CABLE
INSULATOR
TERMINAL

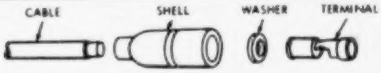
1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF TERMINAL WELL.
2 - SLIDE INSULATOR OVER CABLE.
3 - INSERT CABLE INTO TERMINAL WELL AND CRIMP.
4 - SLIDE INSULATOR OVER CRIMPED END OF TERMINAL.

A - TERMINAL-TYPE CABLE CONNECTORS


CABLE
SHELL
"C" WASHER
FERRULE

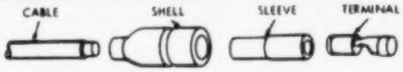
1 - STRIP CABLE INSULATION EQUAL TO DEPTH OF FERRULE WELL.
2 - SLIDE SHELL OVER CABLE.
3 - INSERT CABLE INTO FERRULE WELL AND CRIMP.
4 - PLACE "C" WASHER OVER CABLE AT CRIMPED JUNCTION AND SLIDE SHEEL OVER "C" WASHER AND TERMINAL.

B - MALE CABLE CONNECTOR


CABLE
SHELL
WASHER
TERMINAL

1 - STRIP CABLE INSULATION APPROXIMATELY 1/8 INCH.
2 - SLIDE SHELL AND WASHER OVER CABLE.
3 - PLACE CABLE IN CYLINDRICAL END OF TERMINAL AND CRIMP.
4 - SLIDE SHELL AND WASHER OVER TERMINAL.

C - FEMALE CABLE CONNECTOR (WITH WASHER)

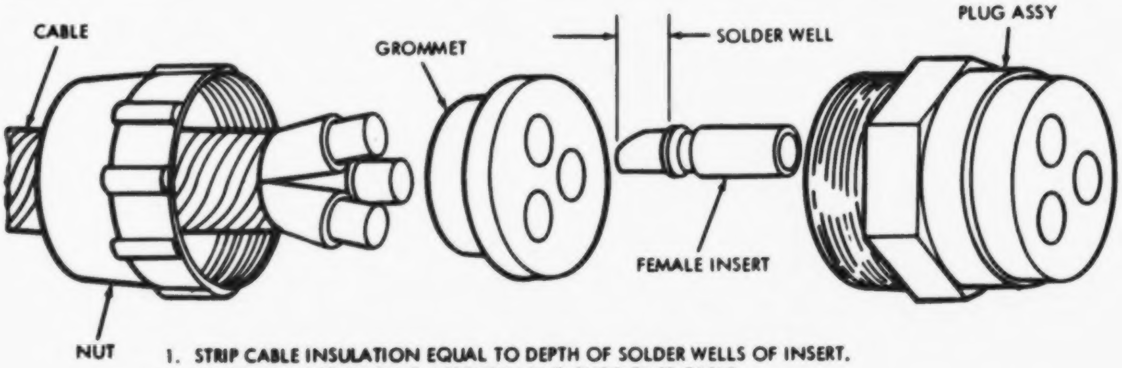

CABLE
SHELL
SLEEVE
TERMINAL

1 - STRIP CABLE INSULATION APPROXIMATELY 1/8 INCH.
2 - SLIDE SHELL AND SLEEVE OVER CABLE.
3 - PLACE CABLE IN CYLINDRICAL END OF TERMINAL AND CRIMP.
4 - SLIDE SHELL AND SLEEVE OVER TERMINAL.

D - FEMALE CABLE CONNECTOR (WITH SLEEVE)

AT 12758

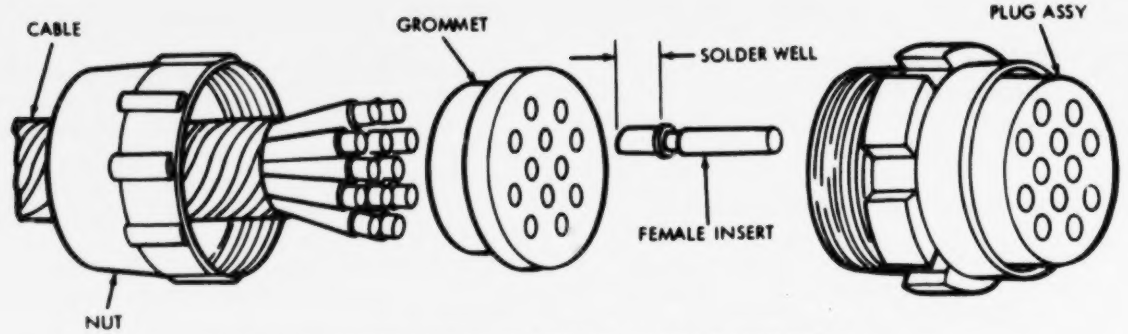
Figure 2-85. Replacing cable connectors.


CABLE
GROMMET
SOLDER WELL
PLUG ASSY
FEMALE INSERT
NUT

1. STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERT.
2. REMOVE NUT FROM PLUG ASSEMBLY AND SLIDE OVER CABLE.
3. REMOVE GROMMET FROM PLUG ASSEMBLY.
4. PASS CABLE ENDS THROUGH GROMMET, INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5. SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY.
6. THREAD NUT TO PLUG ASSEMBLY.

A - FEMALE-TYPE PLUG ASSEMBLY (WITH HEXAGON COUPLING PLUG)

AT 12759

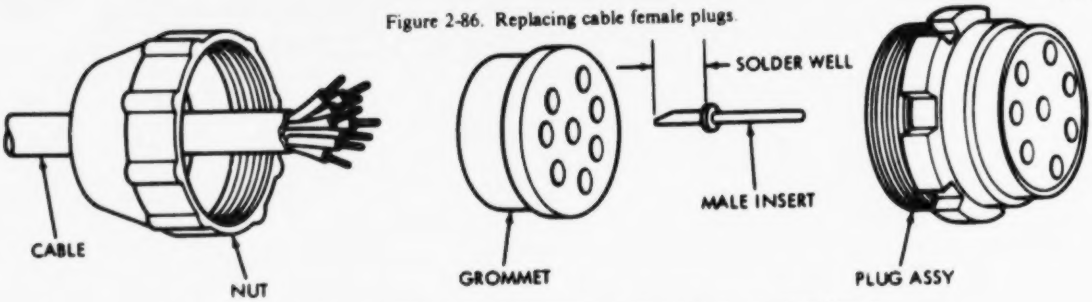

CABLE
GROMMET
SOLDER WELL
PLUG ASSY
FEMALE INSERT
NUT

1. STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2. REMOVE NUT FROM PLUG ASSEMBLY AND SLIDE OVER CABLE.
3. REMOVE GROMMET FROM PLUG ASSEMBLY.
4. PASS CABLE ENDS THROUGH GROMMET, INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5. SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY UNTIL SEATED.
6. THREAD NUT TO PLUG ASSEMBLY.

B - FEMALE-TYPE PLUG ASSEMBLY (WITH SPLINED PLUG)

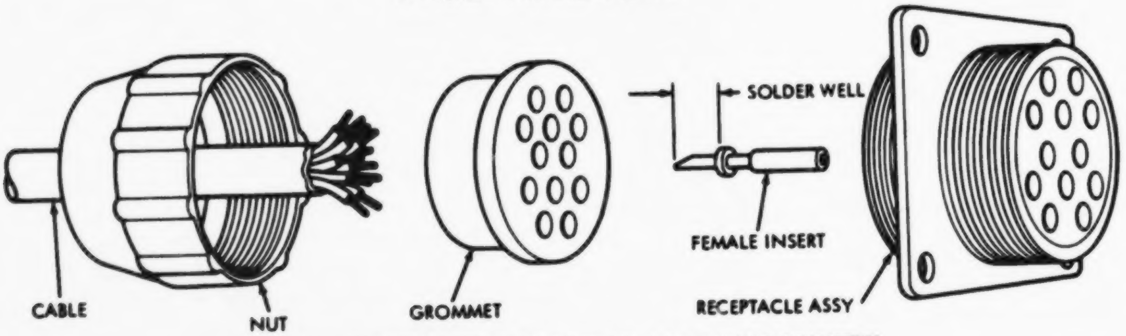
AT 12759

Figure 2-86. Replacing cable female plugs.


SOLDER WELL
MALE INSERT
CABLE
NUT
GROMMET
PLUG ASSY

1. STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2. REMOVE NUT FROM PLUG ASSEMBLY AND SLIDE OVER CABLE.
3. REMOVE GROMMET FROM PLUG ASSEMBLY.
4. PASS CABLE ENDS THROUGH GROMMET, INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5. SLIDE GROMMET OVER INSERTS AND PRESS INTO PLUG ASSEMBLY UNTIL SEATED.
6. THREAD NUT TO PLUG ASSEMBLY.

A - MALE-TYPE PLUG ASSEMBLY


SOLDER WELL
FEMALE INSERT
CABLE
NUT
GROMMET
RECEPTACLE ASSY

1. STRIP CABLE INSULATION EQUAL TO DEPTH OF SOLDER WELLS OF INSERTS.
2. REMOVE NUT FROM PLUG ASSEMBLY AND SLIDE OVER CABLE.
3. REMOVE GROMMET FROM RECEPTACLE ASSEMBLY.
4. PASS CABLE ENDS THROUGH GROMMET, INSERT INTO SOLDER WELLS OF INSERTS AND SOLDER.
5. SLIDE GROMMET OVER INSERTS AND PRESS INTO RECEPTACLE ASSEMBLY.
6. THREAD NUT TO RECEPTACLE ASSEMBLY.

B - FEMALE-TYPE RECEPTACLE ASSEMBLY

AT 12760

Figure 2-87. Replacing cable male plugs and female receptacles.

Section XIII. LIGHTING SYSTEM AND BATTERIES

2-66. Battery Cables and Associated Parts

a. Removal of Battery Cables (figs 2-88 and 2-89).

(1) Raise center seat in cab.

NOTE

Ground straps must be disconnected before removal of battery cables to avoid possibility of arcing and damage of materiel. Remove ground cables first and install ground cables last when servicing batteries.

(2) Remove two screws, six toothed lockwashers, and two nuts securing cable assemblies to ground straps.

(3) Remove six screws and nuts securing cable assemblies to three battery ground terminals.

(4) Remove nine boots from battery terminals.

(5) Remove 18 screws and nuts securing cable assemblies to nine battery terminals.

b. Installation. Install battery cables by securing cable assemblies to nine battery terminals with 18 screws

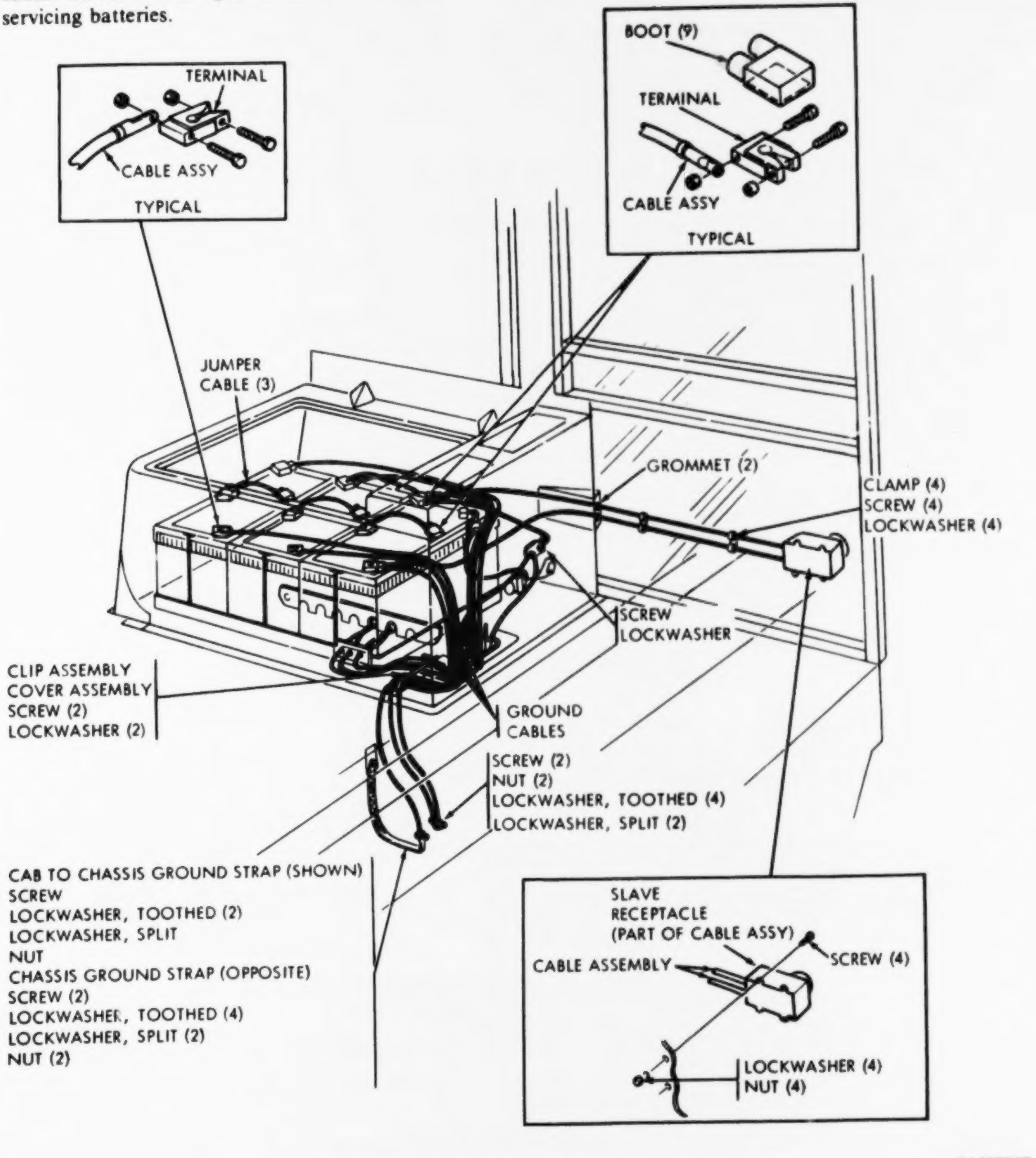

TERMINAL
CABLE ASSY
TYPICAL
BOOT (9)
TERMINAL
CABLE ASSY
TYPICAL
JUMPER CABLE (3)
GROMMET (2)
CLAMP (4)
SCREW (4)
LOCKWASHER (4)
SCREW
LOCKWASHER
CLIP ASSEMBLY
COVER ASSEMBLY
SCREW (2)
LOCKWASHER (2)
GROUND CABLES
SCREW (2)
NUT (2)
LOCKWASHER, TOOTHED (4)
LOCKWASHER, SPLIT (2)
CAB TO CHASSIS GROUND STRAP (SHOWN)
SCREW
LOCKWASHER, TOOTHED (2)
LOCKWASHER, SPLIT
NUT
CHASSIS GROUND STRAP (OPPOSITE)
SCREW (2)
LOCKWASHER, TOOTHED (4)
LOCKWASHER, SPLIT (2)
NUT (2)
SLAVE RECEPTACLE (PART OF CABLE ASSY)
CABLE ASSEMBLY
SCREW (4)
LOCKWASHER (4)
NUT (4)
TA027557

Figure 2-88. Battery cables.

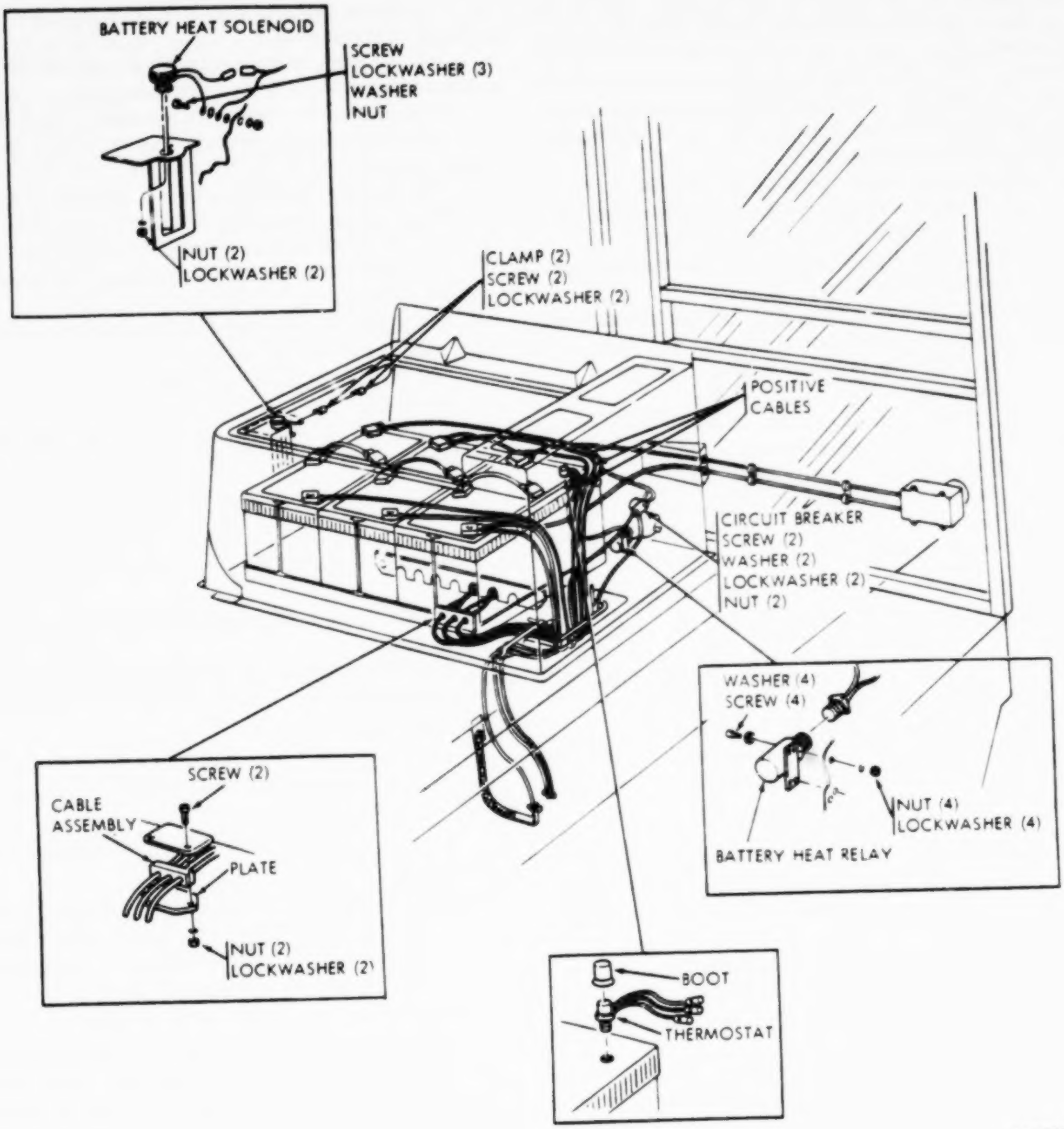

BATTERY HEAT SOLENOID
SCREW
LOCKWASHER (3)
WASHER
NUT
NUT (2)
LOCKWASHER (2)
CLAMP (2)
SCREW (2)
LOCKWASHER (2)
POSITIVE CABLES
CIRCUIT BREAKER
SCREW (2)
WASHER (2)
LOCKWASHER (2)
NUT (2)
WASHER (4)
SCREW (4)
NUT (4)
LOCKWASHER (4)
BATTERY HEAT RELAY
SCREW (2)
CABLE ASSEMBLY
PLATE
NUT (2)
LOCKWASHER (2)
BOOT
THERMOSTAT
TA027558

Figure 2-89. Battery cables and associated parts.

and nuts. Place nine boots over battery terminals. Secure cable assemblies to three battery ground terminals with six screws and nuts. With two screws, six toothed lockwashers, and two nuts, secure cable assemblies to ground straps. Lower center seat in cab.

c. *Removal of Other Cables (figs. 2-88 and 2-89).*

(1) Remove two grommets.

(2) Remove screw and lockwasher securing cable assembly to circuit breaker.

(3) Remove four clamps, screws, and lockwashers securing cable assembly.

(4) Remove four screws, lockwashers, and nuts securing cover to slave receptacle.

(5) Remove two screws and four lockwashers securing two cable assemblies to slave receptacle.

(6) Remove two screws and lockwashers securing clip assembly and cover assembly.

(7) Remove two screws, lockwashers, and nuts securing cable assembly to plate.

d. *Installation of Cables.* Place cable assemblies on plate and secure with two screws, lockwashers, and nuts. Secure clip assembly and cover assembly with two screws two screws and lockwashers. Attach cable assemblies to slave receptacle with two screws and four lockwashers. Secure cover to slave receptacle with four screws, lockwashers, and nuts. Secure cable assembly with four clamps, screws, and lockwashers. Attach cable assembly to circuit breaker with screw and washer and install two grommets.

e. Replacement of Ground Straps (fig. 2-88).

(1) Remove two screws, six toothed lockwashers, and two nuts securing cable assemblies.

(2) Remove screw, two toothed lockwashers, and nuts securing cab ground strap.

(3) Remove two screws, four toothed lockwashers, and two nuts securing chassis ground strap.

(4) Replace cab and chassis ground straps.

f. Installation

(1) Position chassis ground strap and secure with two screws, four toothed lockwashers, and two nuts.

(2) Position cab ground strap and secure with screw, two toothed lockwashers, and nuts.

(3) Secure cable assemblies with two screws, six toothed lockwashers, and two nuts.

2-67. Batteries and Associated Parts

a. Removal of Batteries (fig. 2-90)

Warning

Ground cables must be removed first and installed last when servicing batteries.

(1) Unfasten two center seat retainers. Lift seat and secure in raised position with seat wire rope/hook assembly.

(2) Remove ground cables.

(3) Remove positive cables.

(4) Remove jumper cables.

(5) Disconnect three thermostat leads.

(6) Remove six nuts, lockwashers, and washers securing retainer assemblies to tray studs. Remove retainers.

(7) Remove rear center battery first.

(8) Remove remaining batteries.

(9) Remove thermostat from battery.

b. Installation.

(1) Install thermostat in battery.

(2) Install batteries. Install rear center battery last.

(3) Position retainer assemblies to tray studs and secure with six nuts, lockwashers, and washers.

(4) Connect three thermostat leads.

(5) Install jumper cables, positive cables, and ground cables.

(6) Lower center seat in cab.

c. Replacement of Battery Thermostat (fig. 2-89).

(1) Disconnect three electrical connectors from thermostat located in left rear corner battery.

(2) Remove boot from top of thermostat and unscrew thermostat from battery.

(3) Replace thermostat.

d. Installation.

(1) Screw thermostat into battery and install boot on top of thermostat.

(2) Connect three electrical connectors to thermostat located in left rear corner battery.

e. Replacement of Battery Heat Relay (fig. 2-89).

(1) Disconnect electrical receptacle from battery heat relay.

(2) Remove four screws, lockwashers, and nuts securing battery heat relay to mounting bracket.

f. Replacement of Battery Heat Solenoid (fig. 2-89).

(1) Disconnect electrical connector from battery heat solenoid.

(2) Remove screw, three lockwashers, washer, and nut securing ground strap.

(3) Replace battery heat solenoid.

g. Installation.

(1) Position battery heat solenoid and install ground strap with screw, three lockwashers, washer, and nut.

(2) Connect electrical connector to battery heat solenoid.

h. Replacement of Battery Circuit Breaker CB10 (fig. 2-89).

(1) Disconnect electrical terminals from battery circuit breaker.

(2) Remove two screws, lockwasher, washers, and nuts securing battery circuit breaker to battery box.

i. Installation.

(1) Position battery circuit breaker to battery box and secure by installing two screws, lockwashers, washers, and nut.

(2) Connect electrical terminals to battery circuit breaker.

2-68. Headlights, Front Composite Lights, Service Turn Lights, Blackout Headlight, and Forward Clearance Light (Figs. 2-91 through 2-98).

a. Replacement or Repair of Headlights.

(1) *Removal* (fig. 2-91). Remove four screws (39) and lockwashers (38) securing headlight brush guard. Swing guard away from headlight. Remove three nuts (37) securing headlight (36) to bumper. Disconnect two electrical connectors from headlight.

(2) *Installation of headlight.* Connect two electrical connectors to headlight. Secure headlight (36) to bumper with three nuts (37). Return brush guard to closed position and secure with screw (39) and lockwashers (38).

(3) *Repair* (fig. 2-92). Repair of the headlights consists of replacement of defective parts of lamp unit. Remove three screws (1) securing ring (2) on front of headlight and remove ring. Remove two screws (5) securing ring (6) to headlight housing (10) and remove ring. Remove lamp unit (3) and disconnect three electrical connectors.

(4) Installation. Assemble lamp unit (3) by connecting three electrical connectors with two screws (5). Secure ring (6) to headlight housing (10). Position ring (2) on front of headlight and secure with three screws (1). Adjust headlight as prescribed in b below.

a. 1 *Battery Cable Routing, M746 Tractor.*

(1) Install and route battery cables as illustrated (Fig. 2-89.1).

(2) Battery terminal lug 8364246 on all inner cables is replaced with lug 7056730 (NSN 5490-00-705-6730) as shown below. This terminal lug will provide a more positive method of attaching cables and will eliminate the cable from working loose from battery.

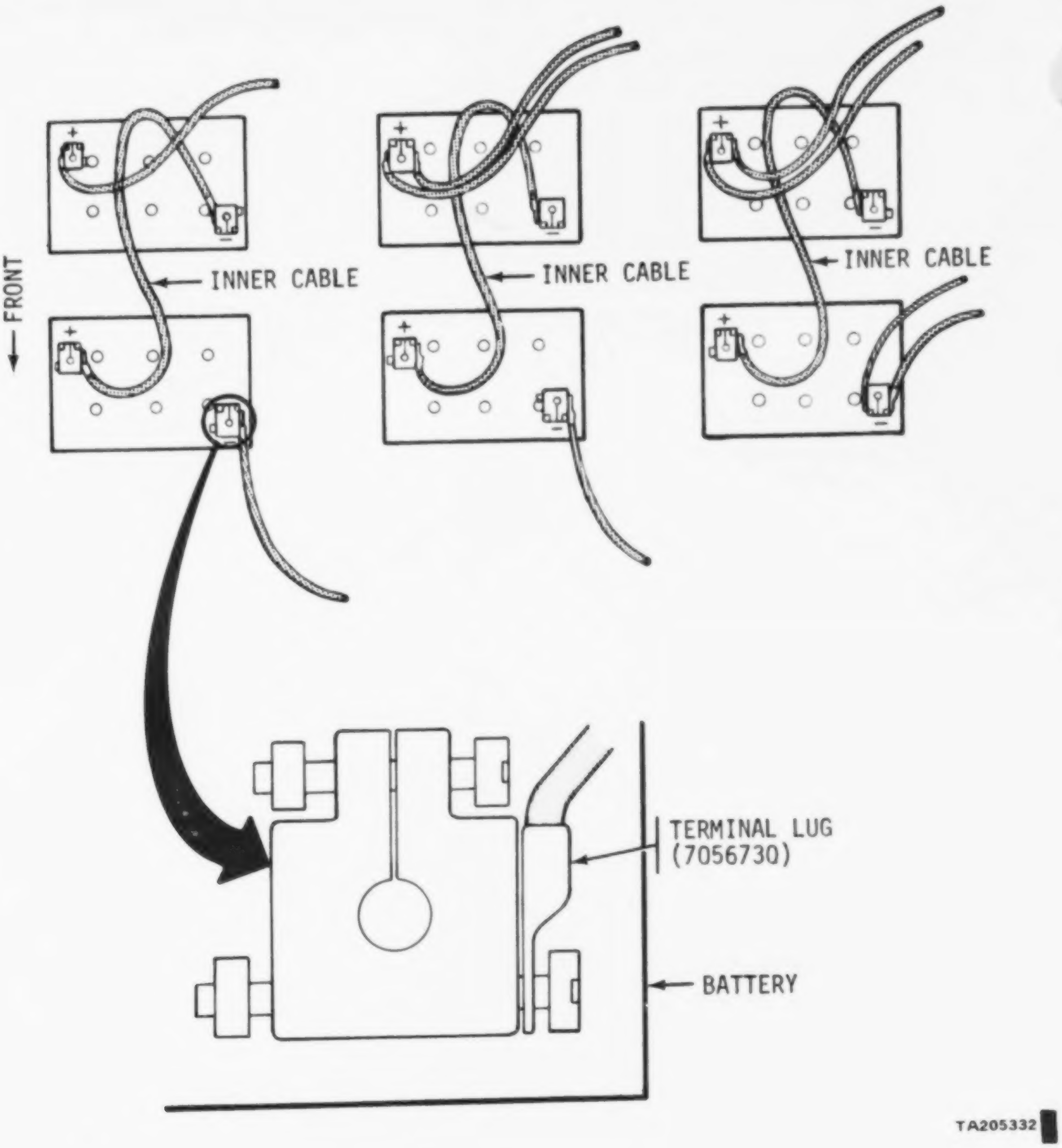

INNER CABLE
INNER CABLE
INNER CABLE
FRONT
+
+
+
+
+
+
TERMINAL LUG
(7056730)
BATTERY
TA205332

Figure 2-89.1. Battery Cable routing, tractor M746.

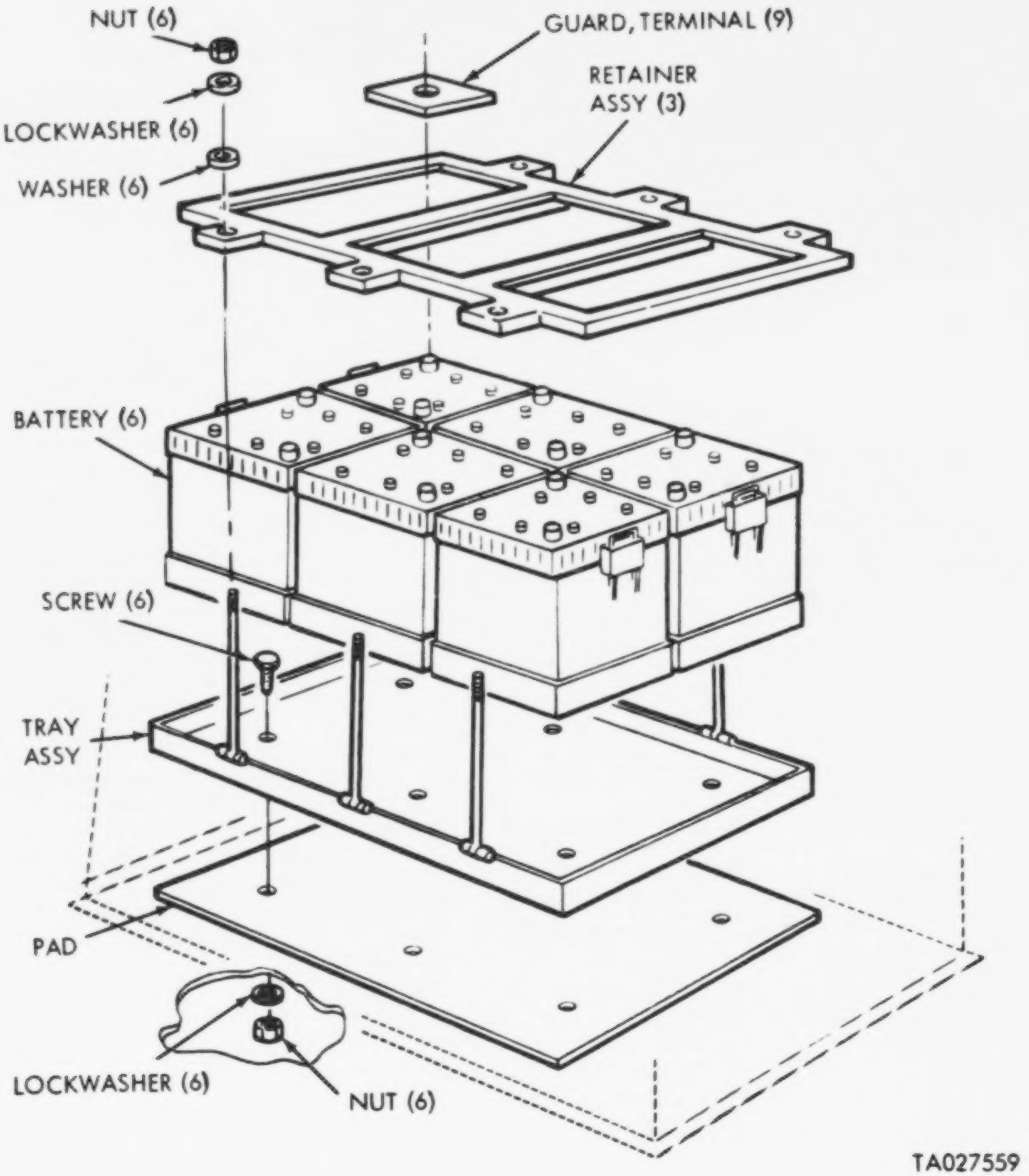
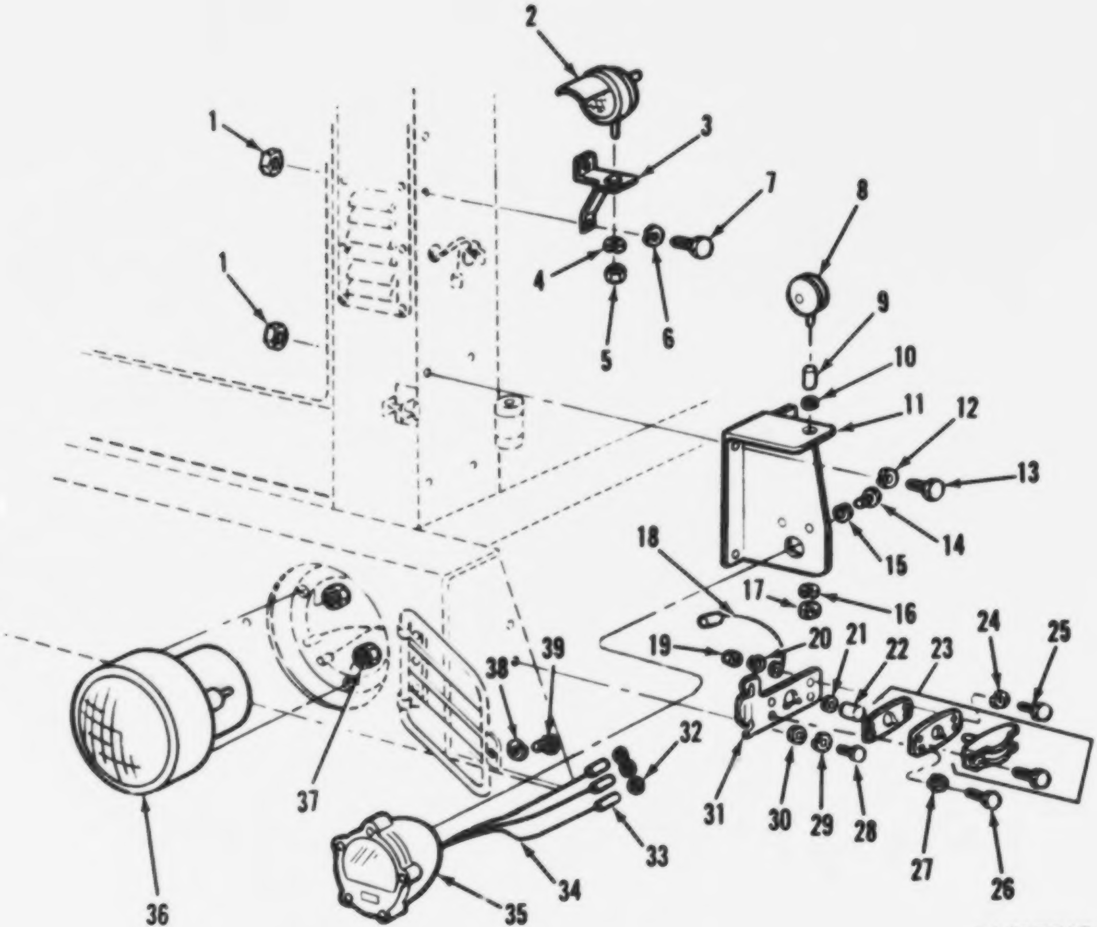
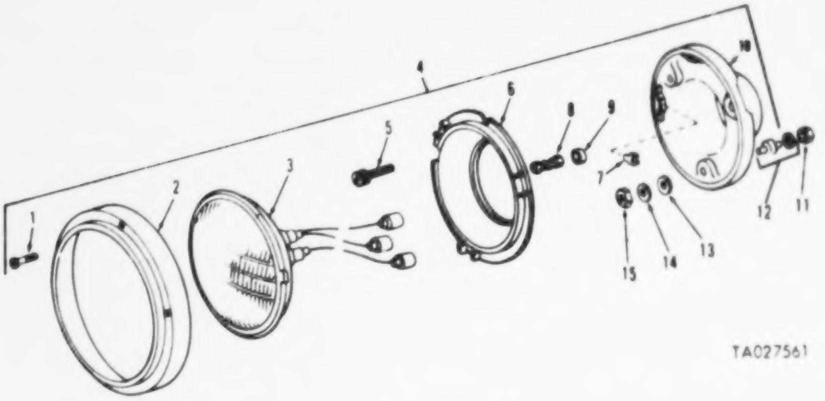

NUT (6)
GUARD, TERMINAL (9)
RETAINER ASSY (3)
LOCKWASHER (6)
WASHER (6)
BATTERY (6)
SCREW (6)
TRAY ASSY
PAD
LOCKWASHER (6)
NUT (6)
TA027559

Figure 2-90. Batteries and associated parts.


2
1
3
7
8
1
4
6
5
9
10
11
12
13
14
15
18
17
16
24
25
19
20
21
22
23
38
39
32
31
30
29
28
27
26
37
33
34
36
35
TA027560

1 Nut (2)
2 Blackout headlight assembly
3 Bracket assembly
4 Lockwasher
5 Nut
6 Lockwasher (2)
7 Screw (2)
8 Service turn light assembly
9 Shell (2)
10 Washer (2)
11 Bracket
12 Lockwasher (8)
13 Screw (8)
14 Screw (4)
15 Lockwasher (4)
16 Lockwasher (2)
17 Nut (2)
18 Lead assembly (2)
19 Nut (2)
20 Lockwasher (2)
21 Washer (2)
22 Shell (2)
23 Clearance light assembly (2)
24 Lockwasher (2)
25 Screw (2)
26 Screw (6)
27 Lockwasher (6)
28 Screw (4)
29 Lockwasher (4)
30 Washer (4)
31 Plate (2)
32 Washer (6)
33 Shell (6)
34 Contact (6)
35 Composite light assembly (2)
36 Headlight assembly (2)
37 Nut (6)
38 Lockwasher (8)
39 Screw (8)

Figure 2-91. Removal or installation of headlights, front composite light, service turn light, blackout headlight, and forward clearance light.



1 Screw (3)
2 Ring
3 Lamp unit
4 Headlamp asembly
5 Screw (2)
6 Ring
7 Nut (2)
8 Connector (3)
9 Grommet (3)
10 Housing
11 Nut, self-locking
12 Mount (3)
13 Washer (3)
14 Washer (3)
15 Nut (3)

Figure 2-92. Headlight assembly

b. Adjustment of Headlights (fig. 2-93).

(1) To reduce service headlight glare and prevent temporary blinding of the operator of the oncoming vehicle, headlights must be adjusted properly. The headlight beam direction is changed by two lamp-unit adjusting screws, located behind holes in rim; one at the top and one on the side. Turn top adjusting screw to change vertical direction of beam, and turn side adjusting screw to change horizontal direction. Adjust lights as detailed in (2) thru (8) below.

(2) Place unloaded vehicle on smooth level surface so that headlights are 25 feet away from a vertical wall or other vertical surface. Centerline of vehicle must be at right angles to verticle surface. Draw line C-C on surface to coincide with centerline of vehicle.

(3) Measure height of headlight center from floor, and mark horizontal line (X-X on fig 2-93) at this height on vertical surface.

(4) Mark line (A-A) 3 inches below horizontal centerline (X-X).

(5) Draw vertical lines (B-B) directly in front of each headlight. Distance between each line B-B and centerline C-C should be same as distance between center of each headlight and center of towing pintle.

(6) Turn on headlights at selector switch and select high beam with headlight beam selector switch.

NOTE

If No. 2 lens (stamped on lens) is used, aim on lower beam.

(7) Cover one headlight while adjusting other. Aim headlight so that center of hot (brightest) spot registers with intersecting lines (A-A and B-B).

(8) After each light is aimed separately, check both lights simultaneously for conformity to line (A-A).

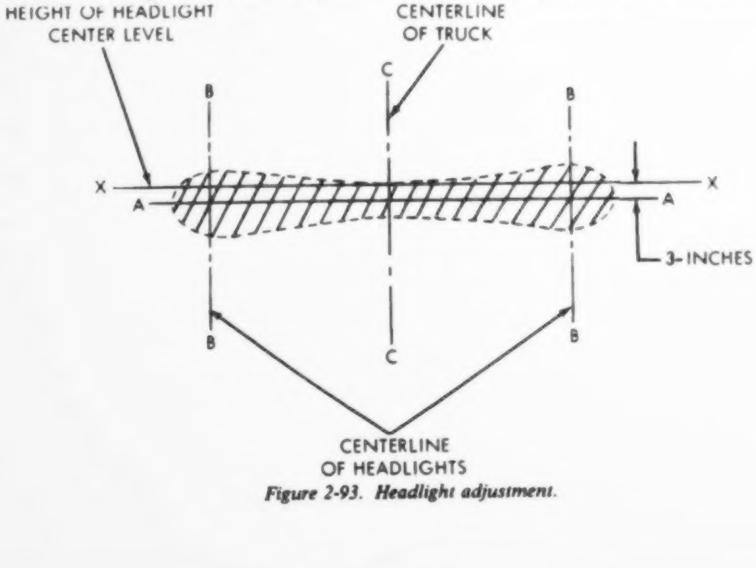


Figure 2-93. Headlight adjustment.

c. Replacement or Repair of Front Composite Light (fig. 2-91).

(1) *Removal.* Disconnect three electrical cables from rear of front composite light (35). Remove two screws (14) and lockwashers (15) securing front composite light to bracket (11).

(2) *Repair (fig. 2-94).* Repair of the front composite light consists of replacement of defective parts or lamps. Remove five screws securing door and lens assembly to body assembly and remove seal. Press in and turn lamp to be replaced and remove lamp. Install lamp by pressing in and turning. Position seal and install door and lens assembly over seal and secure door and lens assembly with five screws.

(3) *Installation.* Install two screws (14) and lockwashers (15) to secure front composite light to bracket (11). Connect three electrical cables to rear of front composite light (35).

d. Replacement of Service Turn Light (fig. 2-91).

(1) *Removal.* Disconnect electrical connector from wiring harness. Remove nut (17) and lockwasher (16) securing light to bracket and remove light. If light is to be replaced, remove shell (9) and washer (10) from light cable for reuse.

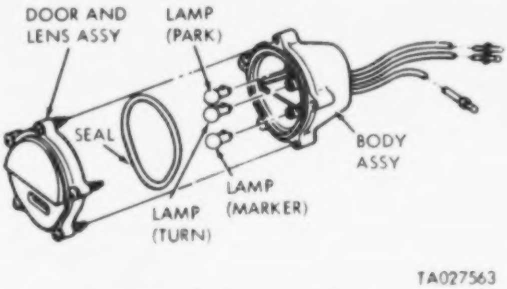
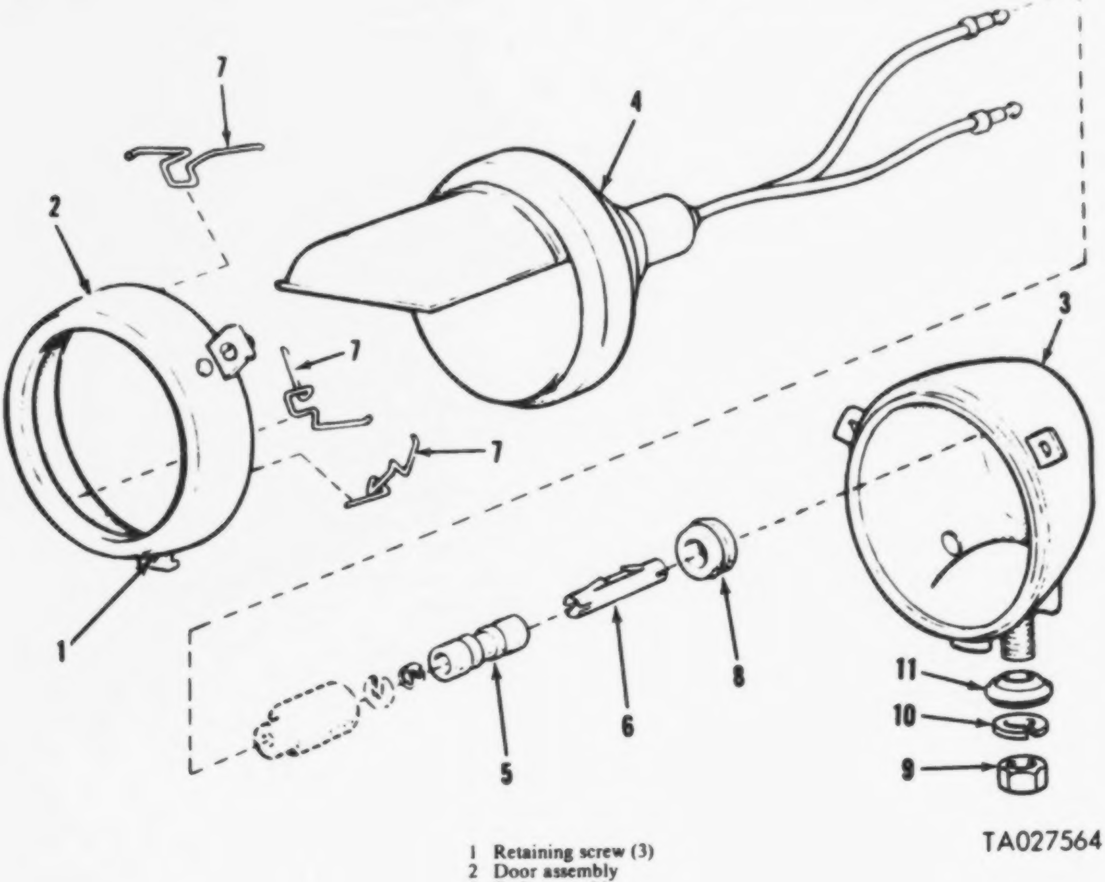


Figure 2-94. Front composite light.



1	Retaining screw (3)
2	Door assembly
3	Body assembly
4	Lamp unit
5	Connector
6	Insert
7	Spring (3)
8	Grommet
9	Nut
10	Lockwasher
11	Grommet

Figure 2-95. Blackout headlight.

(2) *Installation.* If new service turn light is to be installed, assemble shell (9) and washer (10) on cable end. Position light in mounting bracket and install lockwasher (16) and nut (17). Connect electrical connector.

e. Replacement or Repair of Blackout Headlight.

(1) *Removal (fig. 2-91).* Disconnect electrical connector from rear of blackout headlight (2). Remove nut (5) and lockwasher (4) securing blackout headlight to mounting bracket (3) and remove light.

(2) *Repair (fig. 2-95).* Repair of blackout headlight consists of replacement of defective parts or lamp unit. Loosen three door retaining screws (1) securing door assembly (2) to body (3) and separate door assembly with lamp from body.

NOTE

The three door retaining screws will remain in door assembly.

Pull lamp unit (4) forward and remove electrical connectors from mounting clip. Disconnect electrical connector (5) and insert (6) from body. Remove three springs (7) securing lamp unit (4) to door assembly (2) and remove lamp unit. Replace grommet (8), if damaged.

(3) *Installation.* Place lamp unit (4, fig. 2-95) in door assembly (2) and secure with three springs (7). Connect electrical connectors to body (6). Place electrical connectors in mounting clips and install lamp unit (4) in body (3). Position door assembly (2) to body (3) and secure door assembly by tightening three door retaining screws (1). Position blackout headlight on mounting bracket (3 fig. 2-91) and secure with nut (5) and lockwasher (4).

(4) *Adjustment.* The blackout headlight may be aimed by loosening lock nut slightly. Aim lamp so that beam distribution on a level road shall be 30 feet wide of uniformly decreasing intensity from a point 20 feet in front of vehicle to a point 100 feet in front of vehicle. The top of the light beam shall not be less than one degree below horizontal. Tighten lock nut to maintain adjustment.

f. Replacement or Repair of Forward Clearance Light.

(1) *Removal.*

NOTE

Items called out by number in this sequence refer to figure 2-91.

(a) Remove two screws and nuts securing door and lens to plate (shown as part of clearance light (23)) and remove door and lens.

(b) Remove screw (25), lockwashers (24) and (20), and nut (19) securing lead assembly (18) to plate (31).

(c) Disconnect and remove lead assembly (18) from wiring harness assembly.

(d) Disconnect socket and wiring assembly shell (22) from wiring harness assembly.

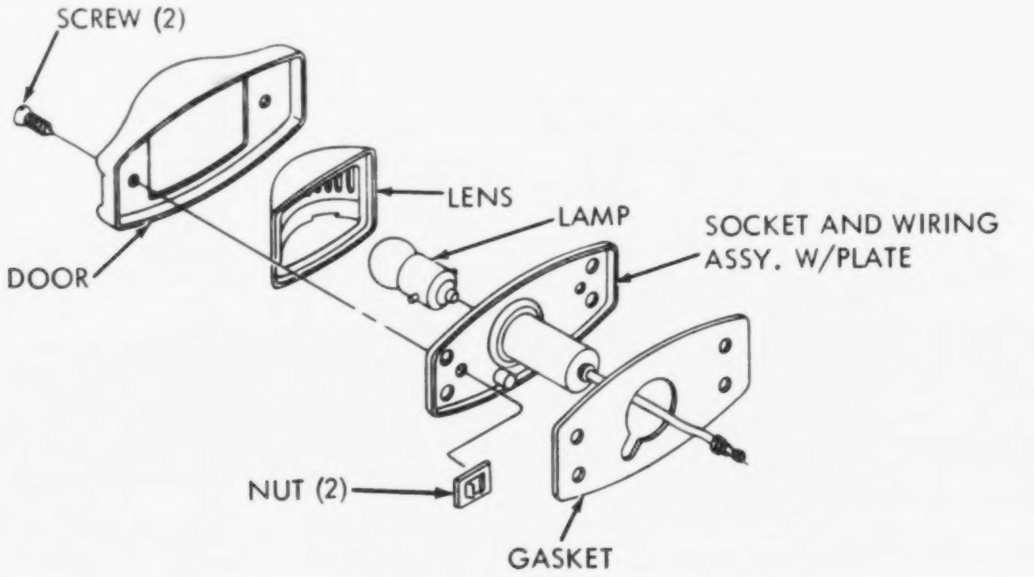
(e) Remove three screws (26) and lockwashers (27) securing plate and gasket (shown as part of clearance light assembly (23)) to plate (31).

(2) *Repair (fig. 2-96).* Repair of front composite light consists of replacement of defective parts or lamp. Press in and turn lamp to be replaced and remove lamp.

(3) *Installation.*

(a) Secure plate and gasket (shown as part of clearance light assembly (23)) to plate (31) using three screws (26) and lockwashers (27).

(b) Connect socket and wiring assembly shell (22) to wiring harness assembly.



TA027565

Figure 2-96. Clearance light — exploded view.

(c) Connect and install lead assembly (18) to wiring harness assembly.

(d) Using screw (25), lockwashers (24) and (20), and nut (19), secure lead assembly (18) to plate (31).

(e) Using screws and nuts, secure door and lens (shown as part of clearance light (23)) to plate (31).

2-69. Rear Composite Light

a. Removal (fig. 2-97).

(1) Disconnect four electrical connectors from rear of light.

(2) Remove screw, lockwasher, and nut securing cable clamp to bracket and remove clamp.

(3) Remove two screws and lockwashers securing rear composite to bracket and remove light.

b. Repair (fig. 2-98).

(1) Repair of rear composite light consists of replacement of defective parts or lamps.

(2) Remove six screws securing door assembly to body assembly and remove door.

(3) Press in and turn lamp to be replaced and remove lamp.

c. Installation.

(1) Install lamp by pressing in and turning.

(2) Using six screws, secure door assembly to body assembly.

(3) Position rear composite light on bracket and secure with two screws and lockwashers.

(4) Position cable clamp on bracket and secure with two screws and lockwashers.

(5) Connect four electrical connectors at rear of light.

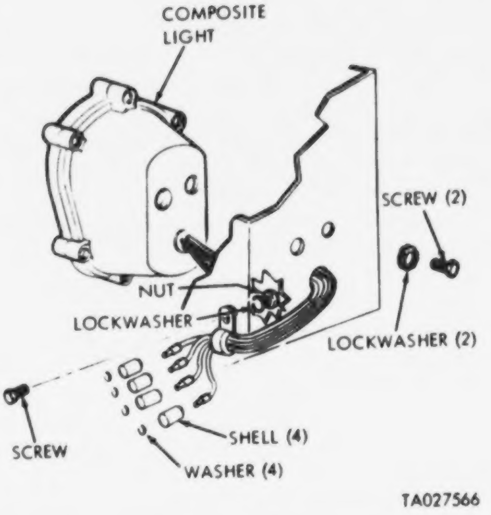

COMPOSITE LIGHT
SCREW (2)
NUT
LOCKWASHER
LOCKWASHER (2)
SCREW
SHELL (4)
WASHER (4)
TA027566

Figure 2-97. Removal or installation of rear composite light.

2-70. Floodlight

a. Removal (fig. 2-99).

(1) Disconnect two wiring harness connectors at rear of flodlight.

(2) Remove strap securing wiring harness.

(3) Disconnect wiring harness receptacle and remove wiring harness.

(4) Remove two nuts securing floodlight to bracket. Remove floodlight.

(5) Remove screw, lockwasher, and nut securing bracket to stanchion assembly. Remove bracket.

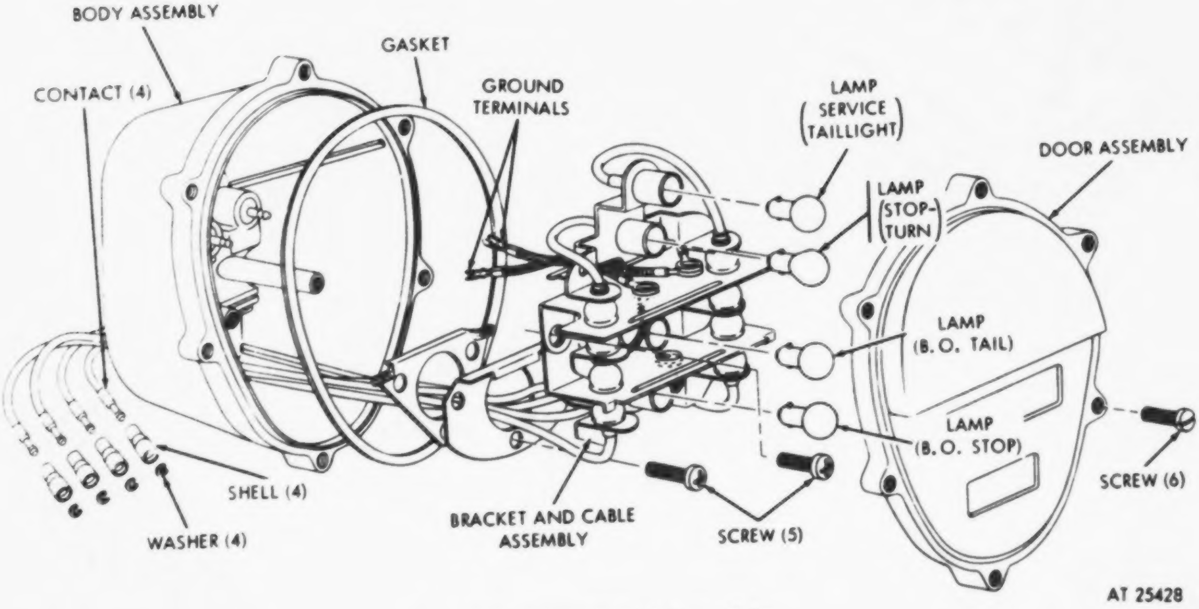

BODY ASSEMBLY
GASKET
CONTACT (4)
GROUND TERMINALS
LAMP (SERVICE TAILLIGHT)
LAMP (STOP-TURN)
DOOR ASSEMBLY
LAMP (B.O. TAIL)
LAMP (B.O. STOP)
SCREW (6)
SHELL (4)
WASHER (4)
BRACKET AND CABLE ASSEMBLY
SCREW (5)
AT 25428

Figure 2-98. Composite stoplight—taillight.

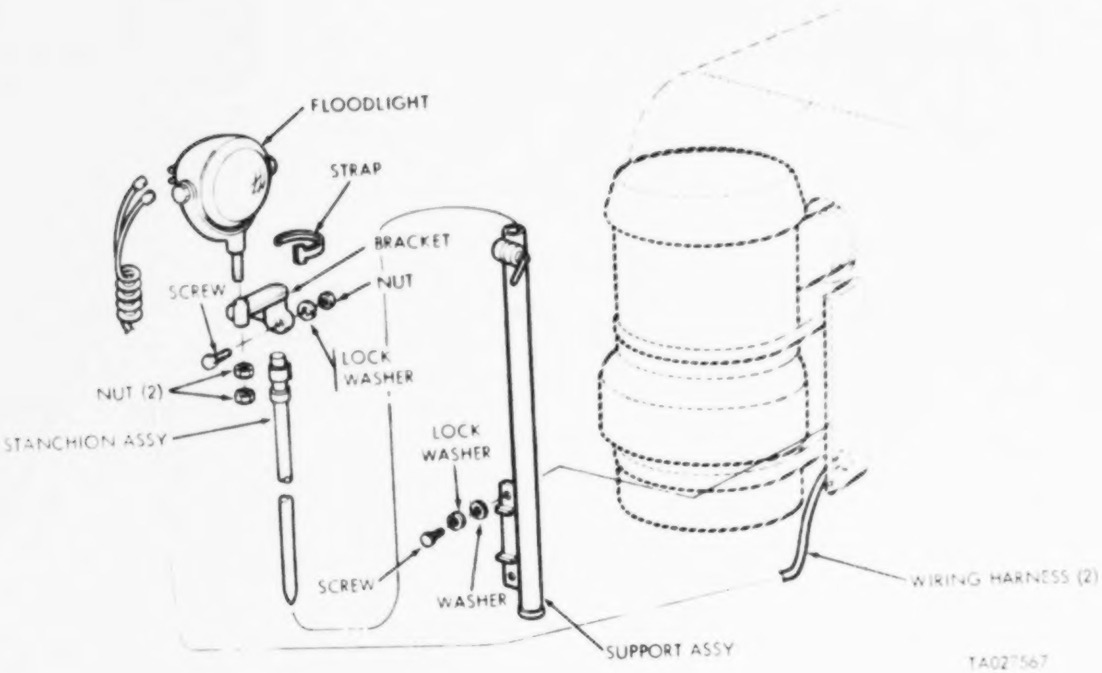


Figure 2-99. Removal or installation of floodlight.

(6) Loosen stanchion assembly locking handle and remove stanchion assembly.

(7) Remove two screws, lockwashers, and washers securing support assembly to mounting bracket. Remove support assembly.

b. Repair (fig. 2-100).

(1) Loosen three screws securing door assembly (16) to housing assembly (7). Separate door and lamp unit (14) together.

(2) Remove two screws securing terminal ends of cable (13) and switch assembly (21) to lamp unit (14).

(3) Disconnect electrical connector on cable (13) and switch assembly (21) from bracket (20).

(4) Remove two screws (17) and lockwasher (18) securing housing assembly (19). Remove switch and housing assemblies.

(5) Inspect door assembly and housing assembly for dents and cracks. Check condition of lugs and clips. Replace damaged parts.

c. Installation.

(1) Secure housing assembly (19) to bracket (20) with two screws (17) and lockwashers (18).

(2) Connect electrical connector on cable (13) and switch assembly (21) to bracket (20).

(3) Position terminal ends of cable (13) and switch assembly (21) in lamp unit (14) and secure with two screws.

(4) Place door and lamp unit (14) together. Position door assembly (16) in housing assembly (7) and install three screws.

(5) Position support assembly to mounting bracket and secure with two screws, lockwashers, and washers.

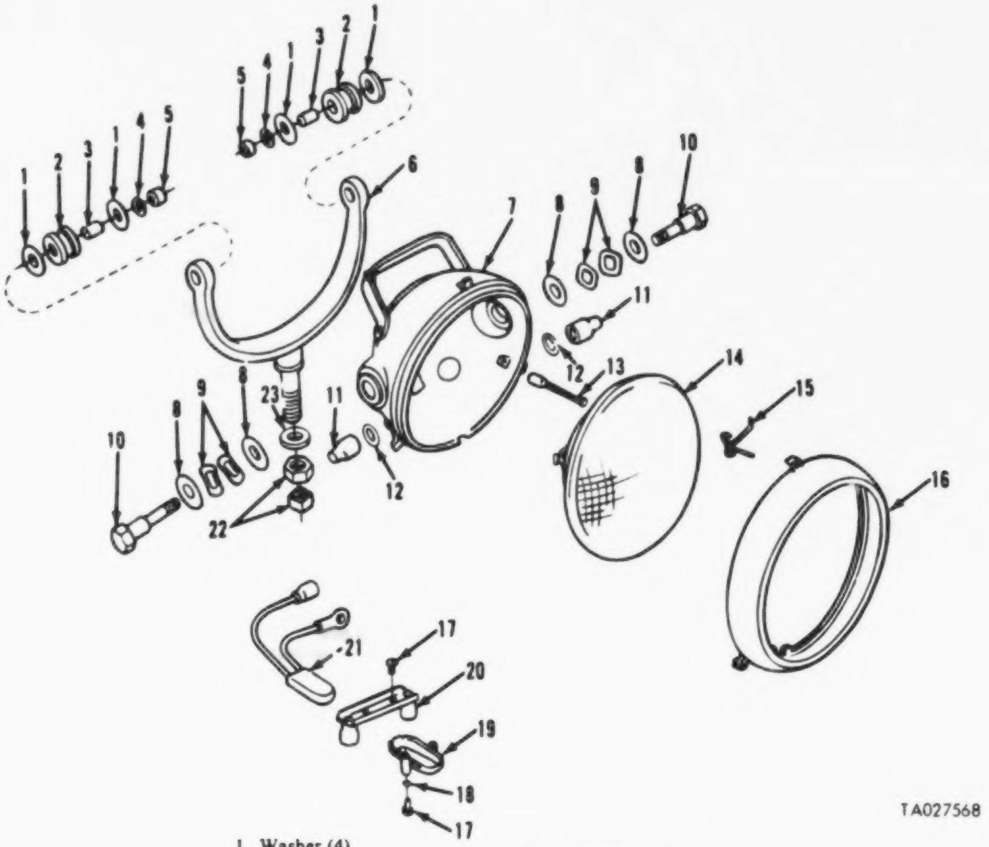
(6) Place stanchion assembly within support assembly and tighten locking handle.

(7) Position bracket on stanchion assembly and install screw, lockwasher, and nut.

(8) Place floodlight on bracket and install two nuts.

(9) Connect wiring harness receptacle and install strap to secure wiring harness.

10) Connect two wiring harness connectors at rear of floodlight.



1	Washer (4)
2	Grommet (2)
3	Spacer (2)
4	Washer, lock (2)
5	Nut (2)
6	Bracket assembly
7	Housing assembly
8	Washer (4)
9	Washer, spring (4)
10	Bolt (2)
11	Connector assembly (2)
12	Grommet (2)
13	Cable assembly
14	Lamp unit
15	Spring (4)
16	Door assembly
17	Screw (4)
18	Washer, lock (2)
19	Housing assembly
20	Bracket
21	Switch assembly
22	Nut (2)
23	Washer (2)

Figure 2-100. Floodlight assembly — exploded view.

2-71. Warning Beacon Light

a. Removal (fig. 2-101).

(1) Remove four nuts (9), four lockwashers (8), and bracket (7).

(2) Disconnect two electrical connectors from rear of light (1) to harness assembly (10).

(3) Lift light (1) off gasket (4) and from top of cab.

(4) Remove three screws (11), lockwashers (12), and clamps (13).

(5) Remove toothed washer (15) and two blind nuts (14).

b. Repair.

(1) Remove two nuts from studs below mounting plate (4). Remove mounting plate.

(2) Inspect gasket (5) and interior of light (1) for damage, deterioration, or wear.

(3) Inspect electrical connectors for damage, wear, or contact corrosion.

(4) Inspect harness assembly (10) for damage, discontinuity, or connector for deformation or pin corrosion.

(5) Inspect blind nuts (14) for thread damage.

(6) Replace defective parts as required. Repair harness assembly, if necessary.

c. Installation.

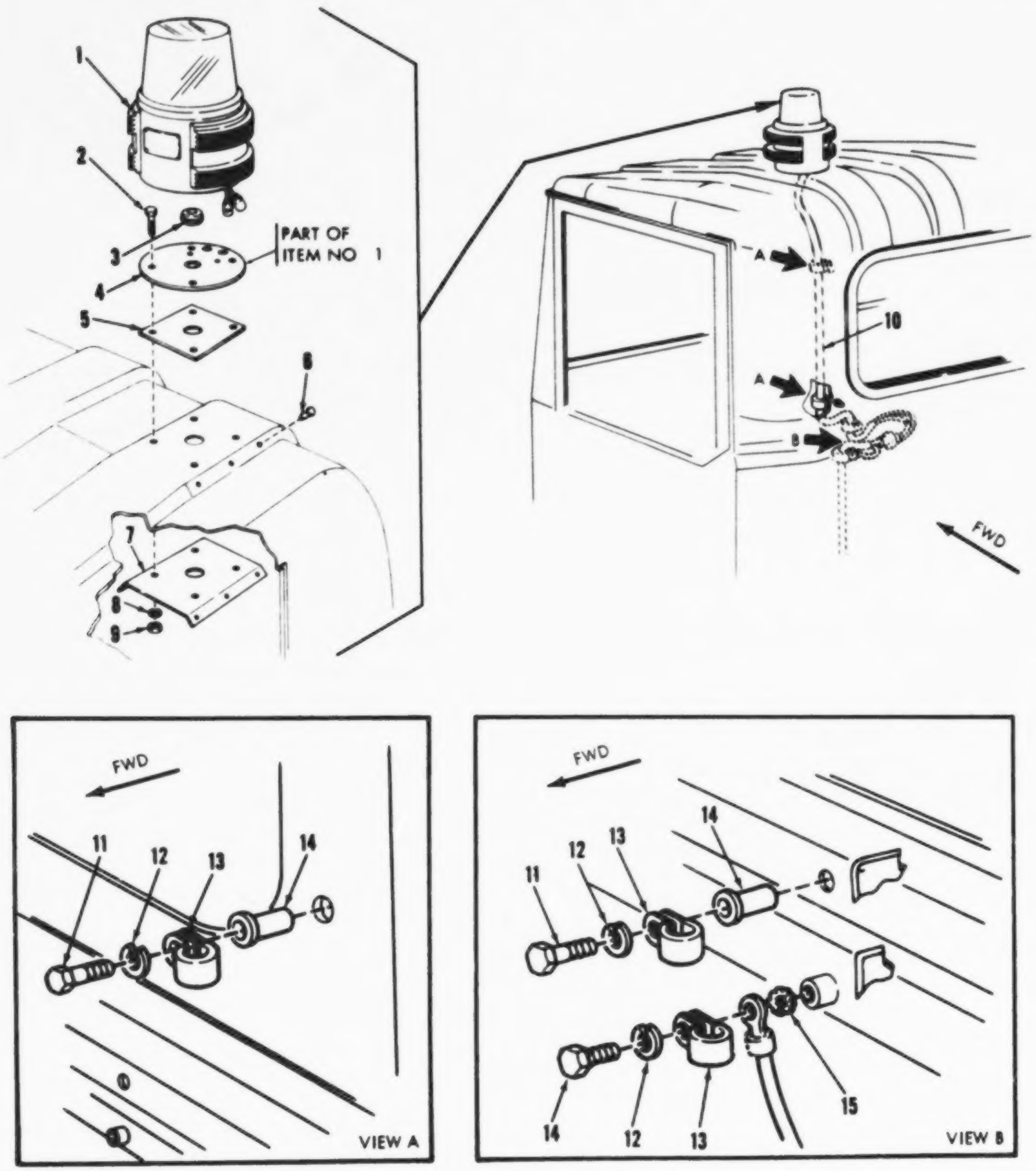
(1) Position mounting plate and install two nuts on studs.

(2) Install toothed washer (15) and two blind nuts (14).

(3) Assemble light and gasket together and position on top of cab.

(4) Connect two electrical connectors at rear of light (1) to harness assembly (10).

(5) Position bracket (7) and secure with four nuts (9), and four lockwashers (8).


1
2
3
4
5
6
7
8
9
PART OF ITEM NO 1
A
A
B
10
FWD
FWD
11
12
13
14
VIEW A
FWD
14
12
13
11
14
12
13
15
VIEW B

TA027569

1 Beacon assembly, warning
2 Screw (4)
3 Grommet
4 Mounting plate
5 Gasket
6 Rivet (6)
7 Bracket
8 Washer (4)
9 Nut (4)
10 Wiring harness
11 Screw (3)
12 Washer (3)
13 Clamp (3)
14 Blind nut (2)
15 Toothed washer

Figure 2-101. Warning beacon light mounting and disassembly.

2-72. Flasher

Fig. 2-102

a. Removal.

(1) Disconnect electrical connector from flasher receptacle.

(2) Remove two screws, two washers, two lockwashers, and nuts securing flasher and plate to cab and remove flasher and plate.

b. Repair. Inspect flasher, plate, and hardware for dents, cracks, and general condition of parts. Replace damaged or inoperable parts.

c. Installtion. Position flasher and plate to cab and secure to cab by installing two screws, washers, lockwashers, and nuts. Attach electrical connector to flasher receptacle.

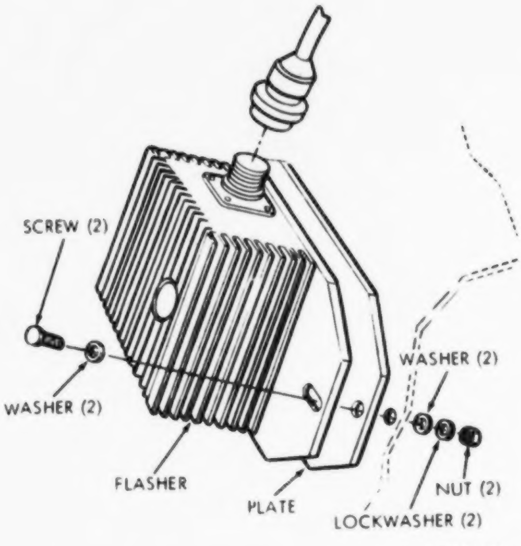


Figure 2-102. Removal or installation of solid state flasher.

Section XIV. INSTRUMENT PANEL, CLUSTERS, SWITCHES, AND GAGES

2-73. General

The majority of the vehicle gages and switches are mounted on two instrument panel assemblies. Two other panels contain the personnel heater controls and circuit breakers. Harness and cable connections related to vehicle systems' operation are mounted behind the front access door. The two main instrument panels are designed for easy replacement if required. Each of the panels is secured in place by appropriate hardware. See figure 2-27 for gages and sending units electrical system schematic and figures 2-140 and 2-141 for instrument panels cable connections.

WARNING

Before attempting any maintenance type operation on instrument panels, make sure the battery ground (negative) cables are disconnected from batteries.

2-74. Left Instrument Panel

NOTE

Items called out by number in this paragraph refer to figure 2-103.

a. Indicators (5, 6, 7, 9, and 10).

(1) *Engine coolant temperature indicator (5).*

(a) Removal. Disconnect two electrical connectors (circuits 27 and 33) from rear of indicator (5). Place hand in front of indicator to prevent indicator from falling and remove two nuts, lockwashers, and bracket. Remove engine coolant temperature indicator from front of instrument panel.

(b) Installation. Place hand in front of indicator to prevent indicator from falling. Position on bracket and install two nuts and lockwashers. Connect two electrical connectors (circuits 27 and 33) at rear of indicator (5).

(2) *Engine oil pressure indicator (6, fig. 2-103).*

(a) Removal. Disconnect two electrical connectors (circuits 27 and 36) from rear of engine oil pressure indicator (6). Place hand in front of indicator to prevent indicator from falling and remove two nuts, lockwashers, and bracket. Remove engine oil pressure indicator from front of instrument panel.

(b) Installation. Position engine oil pressure indicator at front of instrument panel. Place hand in front of indicator to prevent indicator from falling and install two nuts, lockwashers, and bracket. Connect two electrical connectors (circuits 27 and 36) at rear of engine oil pressure indicator (6).

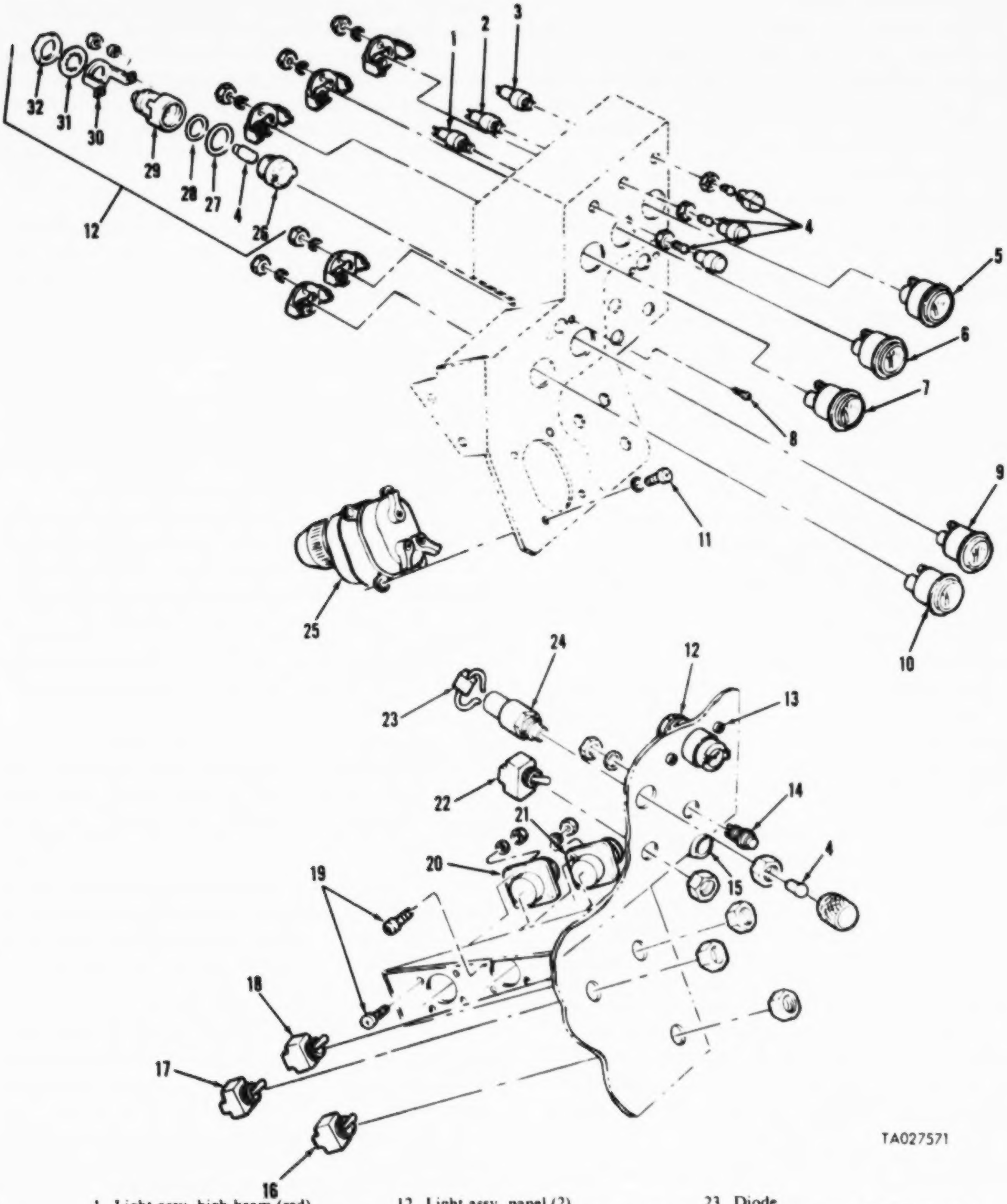
(3) *Transmission oil temperature indicator (7, fig. 2-103).*

(a) Removal. Disconnect two electrical connectors (circuits 27 and 324) from rear of transmission oil temperature indicator (7). Place hand in front of indicator to prevent indicator from falling and remove two nuts, lockwashers, and bracket. Remove transmission oil pressure indicator from front of instrument panel.

(b) Installation. Position transmission oil pressure indicator at front of instrument panel. Place hand in front of indicator to prevent indicator from falling and install two nuts, lockwashers, and bracket. Connect two electrical connectors (circuits 27 and 324) at rear of transmission oil temperature indicator (7).

(4) *Fuel indicator (9, fig. 2-103).*

(a) Removal. Disconnect two electrical connectors (circuits 27 and 30) from rear of fuel indicator (9). to prevent indicator from falling and remove two nuts, lockwashers and bracket. Remove fuel indicator from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TA027571

1	Light assy, high beam (red)
2	Light assy, transm/eng warning (red)
3	Light assy, transm LO pressure (red)
4	Lamp (5)
5	Indicator, eng coolant temp.
6	Indicator, oil press. eng.
7	Indicator, trans. temp.
8	Screw (2), lockwasher (2), nut (2)
9	Indicator, fuel
10	Indicator, voltage
11	Screw (4), lockwasher (4)
12	Light assy, panel (2)
13	Screw (2), lockwasher (2), nut (2)
14	Switch, buzzer cutoff
15	Grommet
16	Switch, windshield wiper
17	Switch, engine stop
18	Switch, auxiliary fuel pump
19	Screw (4), lockwasher (4), nut (4)
20	Receptacle J1
21	Receptacle J2
22	Switch, winch PTO
23	Diode
24	Light assy, winch PTO (yellow)
25	Switch, light
26	Lens
27	Gasket
28	Gasket
29	Body
30	Bracket
31	Lockwasher
32	Bond nut

Figure 2-103. Left instrument panel — exploded view.

front of instrument panel.

(b) Installation. Position fuel indicator at front of instrument panel. Place hand in front of indicator to prevent indicator from falling and install two nuts, lockwashers, and bracket. Connect two electrical connectors (circuits 27 and 30) to rear of fuel indicator (9).

(5) *Voltage indicator (10, fig. 2-103).*

(a) Removal. Disconnect two electrical connectors (circuits 27 and grd) from rear of voltage indicator (10). Place hand in front of indicator to prevent indicator from falling and remove two nuts, lockwashers, and bracket. Remove voltage indicator from front of instrument panel.

(b) Installation. Position voltage indicator at front of instrument panel. Place hand in front of indicator to prevent indicator from falling and install two nuts, lockwashers, and bracket. Connect two electrical connectors (circuits 27 and grd) at rear of voltage indicator (10).

b. Press-to-Test Lights (fig. 2-103).

NOTE

The left instrument panel press-to-test lights are removed and installed in the same manner. The high beam indicator light (1), the transmission low pressure warning light (3), and the transmission/engine warning light (2) are warning lights with red lenses. The winch PTO light (24) is an indicator light with a yellow lens.

(1) *Replacement of lamp.* Unscrew light assembly cap. Push unserviceable lamp (4) in and turn to release. For replacement, push new lamp in and turn to lock in. Screw on light assembly cap.

(2) *Replacement of light assembly.* Unsolder four cables (1, 509, 519, and 655) from rear of light assembly (1, 2, 3, or 26). Remove diode (23) from rear of light (24). Unscrew cap (with lens) from light asembly. Remove nut securing light assembly to instrument panel. Remove light assembly. Remove lamp from light assembly.

(3) *Installation.* Secure lamp in light assembly. Position light assembly on instrument panel and install nut. Tighten cap (with lens) on light assembly. Install diode (23) at rear of light (24). Solder four cables (1, 509, 519, and 655) at rear of light assembly (1, 2, 3, or 26).

(4) *Test light assembly.* Energize circuit and observe that light is working. If power plant pressure and temperature are normal, press cap to check if lamp is working.

c. Panel Lights (fig. 2-103).

(1) *Removal*

NOTE

There are two instrument panel lights (12) and the removal procedures are the same for both lights.

Disconnect electrical connector (circuit 40) from rear of instrument panel light assembly. Remove lamp cap (lens). Remove lamp from lampholder and gasket to instrument panel and remove lampholder and gasket. Remove nut and lockwasher securing bracket to lampholder and separate bracket from lampholder.

(2) *Installation.* Secure bracket to lampholder with nut and lockwasher. Position lampholder and gasket on instruments panel and install two screws. Install lamp in lampholder and install lamp cap (lens). Connect electrical connector (circuit 40) at rear of instrument panel light assembly.

d. Switches.

(1) *Low air buzzer cutoff switch (14, fig. 2-103).*

(a) Removal. Disconnect two soldered electrical connections (circuits 85 and grd) from rear of low air auxiliary buzzer shutoff switch (14). Unscrew and remove nut and washer from rear of instrument panel. Remove switch from front of instrument panel.

(b) Installation. Position switch in front of instrument and secure with nut and washer at rear of instrument panel. Connect by soldering two electrical connections (circuits 85 and grd) at rear of low air auxiliary buzzer shutoff switch (14).

(2) *Windshield wiper switch (fig. 2-103).*

(a) Removal. Unsolder two electrical connectors (circuits 71 - 71A) from rear of windshield wiper switch (16). Unscrew and remove nut from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position switch at rear of instrument panel and secure by installing nut at front of instrument panel. Solder three electrical connectors (circuits 71, 71A, 71B) at rear of windshield wiper switch (16).

(3) *Engine stop switch (17, fig. 2-103).*

(a) Removal. Disconnect three electrical connections (circuits 54, 76, 459A) from rear of engine stop switch (17). Unscrew and remove nut from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position switch (17) at rear of instrument panel and secure by installing nut at front of instrument panel. Connect three electrical connectors (circuits 54, 76, 459A) at rear of engine stop switch (17).

(4) *Fuel pump switch (18, fig. 2-103).*

(a) Removal. Disconnect two electrical connectors (circuits 76A, 76B) from rear of auxiliary fuel pump switch (18). Unscrew and remove nut from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position switch (18) at rear of instrument panel and secure by installing nut at front of instrument panel. Connect two electrical connectors (circuits 76A, 76B) at rear of auxiliary fuel pump switch (18).

(5) *Winch PTO switch (22, fig. 2-103).*

(a) Removal. Disconnect three electrical connections (circuits 471, 471A, 471B) from rear of winch PTO switch (22). Unscrew and remove nut from front of instrument panel. Remove switch.

(b) Installation. Position switch (22) at rear of instrument panel and secure by installing nut at front of

instrument panel. Connect three electrical connectors (circuits 471, 471A, 471B) at rear of winch PTO switch (22).

(6) *Driving light switch (25, fig. 2-103).*

(a) *Removal.* Disconnect electrical receptacle from rear of driving light switch assembly (25). Remove four screws and lockwashers (11) securing switch assembly to rear of instrument panel and remove switch assembly.

(b) *Installation.* Position switch assembly (25) at rear of instrument panel and secure by installing four screws and lockwashers (11). Connect electrical receptacle at rear of driving light switch assembly (25).

e. *Receptacles (fig. 2-103).*

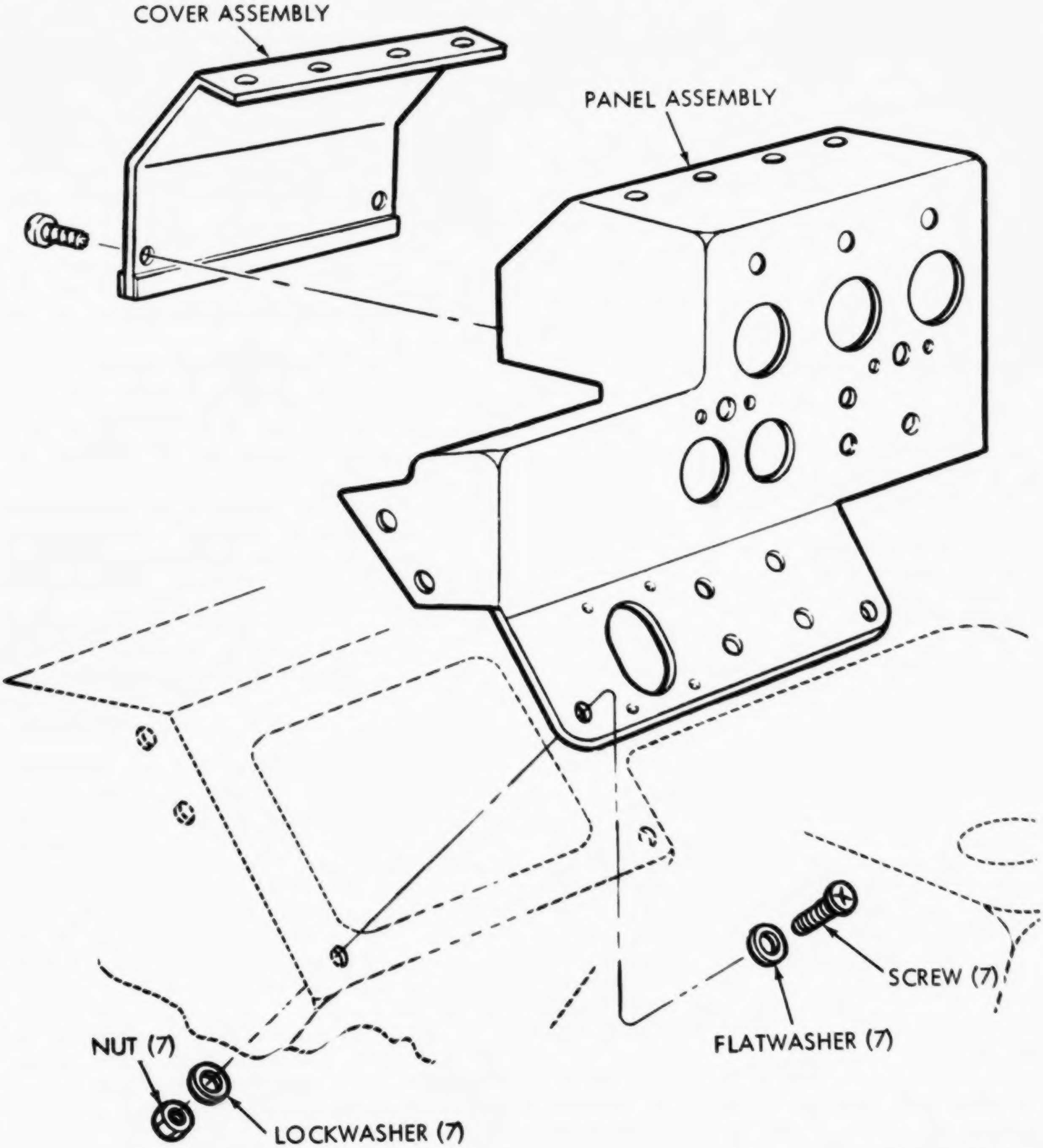

COVER ASSEMBLY
PANEL ASSEMBLY
SCREW (7)
FLATWASHER (7)
NUT (7)
LOCKWASHER (7)
TA027572

Figure 2-104. Removal or installation of left instrument panel.

NOTE

There are two electrical receptacles (20 and 21) mounted to the side of the instrument panel. The removal procedures are the same for both receptacles.

(1) *Removal.* Disconnect electrical wiring harness connector from receptacle. Remove four screws, lockwashers and nuts securing receptacle to instrument panel and remove receptacle.

(2) *Installation.* Position receptacle on instrument panel and secure by installing four screws, lockwashers, and nuts. Connect electrical wiring harness connector to receptacle.

f. Instrument Panel (fig. 2-104).

NOTE

The instrument panel is removed after the cables have been disconnected.

(1) *Removal.* Remove seven screws, washers, lockwashers, and nuts securing panel assembly to cab. Pull panel assembly away from cab.

(2) *Installation.* Position panel assembly on cab. Secure panel assembly with seven screws, washers, lockwashers, and nuts.

2-75. Right Instrument Panel.

NOTE

Items called out by number in this paragraph refer to figure 2-105.

a. Removal of Tachograph (See para 2-76d).

b. Press-to-Test Lights (fig. 2-105).

NOTE

The right instrument panel press-to-test lights are removed and installed in the same manner. The tractor low pressure warning light (5), the trailer low pressure warning light (6), and the auxiliary power steering pressure warning light (10) are warning lights with red lenses. The warning beacon light (11) is an indicator light with a yellow lens.

(1) *Replacement of lamp.* Unscrew light assembly cap. Push unserviceable lamp (3) in and turn to release. Install lamp in reverse manner.

(2) *Replacement of light assembly.* Disconnect three soldered cables from rear of light assembly (5, 6, 10, or 11). Unscrew cap (with lens) from light assembly. Remove nut securing light assembly to instrument panel. Remove light assembly. Remove lamp from light assembly. Install light assembly in reverse manner.

(3) *Installation.* Place lamp in light assembly. Position light assembly on instrument panel and secure by installing nut. Install cap (with lens) on light assembly. Solder three cables (5, 6, 10, or 11) to rear of light assembly.

(4) *Test light assembly.* Energize circuit and observe that light is working. If air and hydraulic system pressures are normal, press cap to check lamp operation.

c. Switches (fig. 2-105).

(1) Starter switch (24).

(a) Removal. Disconnect three electrical connections (circuits 459, 459A, and relay) from rear of starter switch (24). Remove screw securing lever (29) and remove lever. Unscrew and remove nut and lockwasher securing switch to instrument panel. Remove switch from front of instrument panel.

(b) Installation. Position starter switch (24) on front of instrument panel and secure by installing nut and lockwasher. Place lever (23) on starter switch (24) and install screw. Connect three electrical connections (circuits 459, 459A, and relay) to rear of starter switch (24).

(2) *Ether start switch (fig. 2-105).*

(a) Removal. Unsolder two electrical connectors (circuits 486, 486A) from rear of ether start switch (9). Unscrew and remove nut and lockwasher from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position ether start switch (9) at rear of instrument panel and secure by installing nut and washer on front of instrument panel. Solder two electrical connectors (circuits 486, 486A) to rear of ether start switch (9).

(3) *Warning beacon switch (fig. 2-105).*

(a) Removal. Unsolder electrical connectors (circuits 325, 325A) from rear of warning beacon switch (12). Unscrew and remove switch nut and lockwasher from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position wiring beacon switch (12) at rear of instrument panel and secure by installing nut and lockwasher on front of instrument panel. Solder two electrical connectors (circuits 325, 325A) to rear of warning beacon switch (12).

(4) *Trailer auxiliary power switch (fig. 2-105).*

(a) Removal. Unsolder two electrical connectors (circuits 37, 37B) from rear of auxiliary power switch (14). Unscrew and remove switch nut and lockwasher from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position trailer auxiliary power switch (14) at rear of instrument panel and secure by installing nut and lockwasher on front of instrument panel. Solder two electrical connectors (circuits 37, 37B) to rear of trailer auxiliary power switch (14).

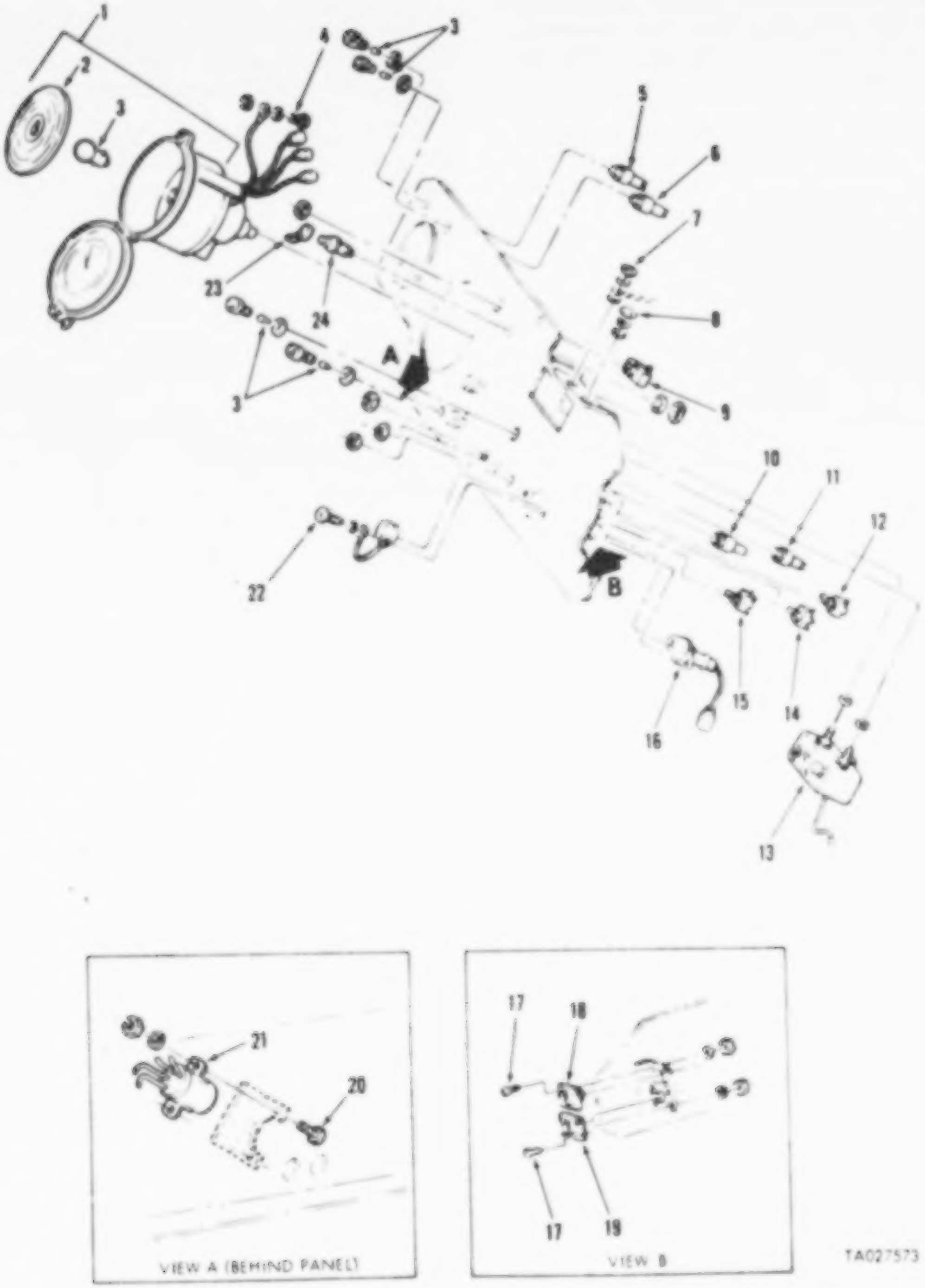
(5) *Blower switch (fig. 2-105).*

(a) Removal. Unsolder electrical connections (circuits 411, 411A, 411B) from rear of blower switch (15). Unscrew and remove switch nut and lockwasher from front of instrument panel. Remove switch from rear of instrument panel.

(b) Installation. Position blower switch (15) at rear of instrument panel and secure by installing nut and lockwasher on front of instrument panel. Solder three electrical connections (circuits 411, 411A, 411B) to rear of blower switch (15).

d. Utility Outlet (fig. 2-105).

(1) *Removal.* Disconnect electrical connector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A
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B
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21
20
VIEW A (BEHIND PANEL)
17
18
17
19
VIEW B
TA027573

1 Tachograph assembly
2 Recording chart
3 Lamp (6)
4 Screw, lockwasher (2)
5 Light assembly, tractor LO pressure warning (red)
6 Light assembly, trailer LO pressure warning (red)
7 Nut, lockwasher (2), flat washer
8 Nut, flat washer (2), lockwasher
9 Switch, toggle, ether start
10 Light assembly, auxiliary P S (red)
11 Light assembly, warning beacon indicator (yellow)
12 Switch, toggle, warning beacon
13 Control box, personnel heater
14 Switch, toggle, trailer auxiliary power
15 Switch, toggle, blower
16 Utility outlet
17 Screw (8), lockwasher (8), nut (8)
18 Receptacle (J4)
19 Receptacle (J5)
20 Screw (2), lockwasher (2), nut (2)
21 Relay, K1
22 Screw (2), lockwasher (2)
23 Lever
24 Starter switch

Figure 2-105. Right instrument panel — exploded view.

(circuit 37A) from rear of utility outlet (16). Unscrew and remove cover from utility outlet. Remove two screws and lockwashers (22) securing utility outlet to rear of instrument panel and remove utility outlet.

(2) *Installation.* Position utility outlet (16) on rear of instrument panel and secure utility outlet (16) by installing two screws and lockwshers (22). Install cover on utility outlet. Connect electrical connector (circuit 37A), at rear of utility outlet (16).

e. Receptacles (fig. 2-105).

NOTE

There are two electrical receptacles (18 and 19) mounted to the side of the instrument panel. The removal procedures are the same for both receptacles.

(1) *Removal.* Disconnect electrical wiring harness connector from receptacle. Remove four screws, lockwashers, and nuts securing receptacle to instrument panel and remove receptacle.

(2) *Installation.* Position receptacle on instrument panel and secure receptacles with four screws, lockwashers, and nuts. Connect electrical wiring harness connector on receptacle.

f. Personnel Heater Control Box Assembly.

(1) *Removal (fig. 2-105)* Disconnect electrical receptacle J6 and connector (circuit 400) from behind and below personnel heater control box assembly (13). Remove nut, lockwasher, ground terminal, lockwasher, and wsher from left side stud. Remove nut, lockwasher,

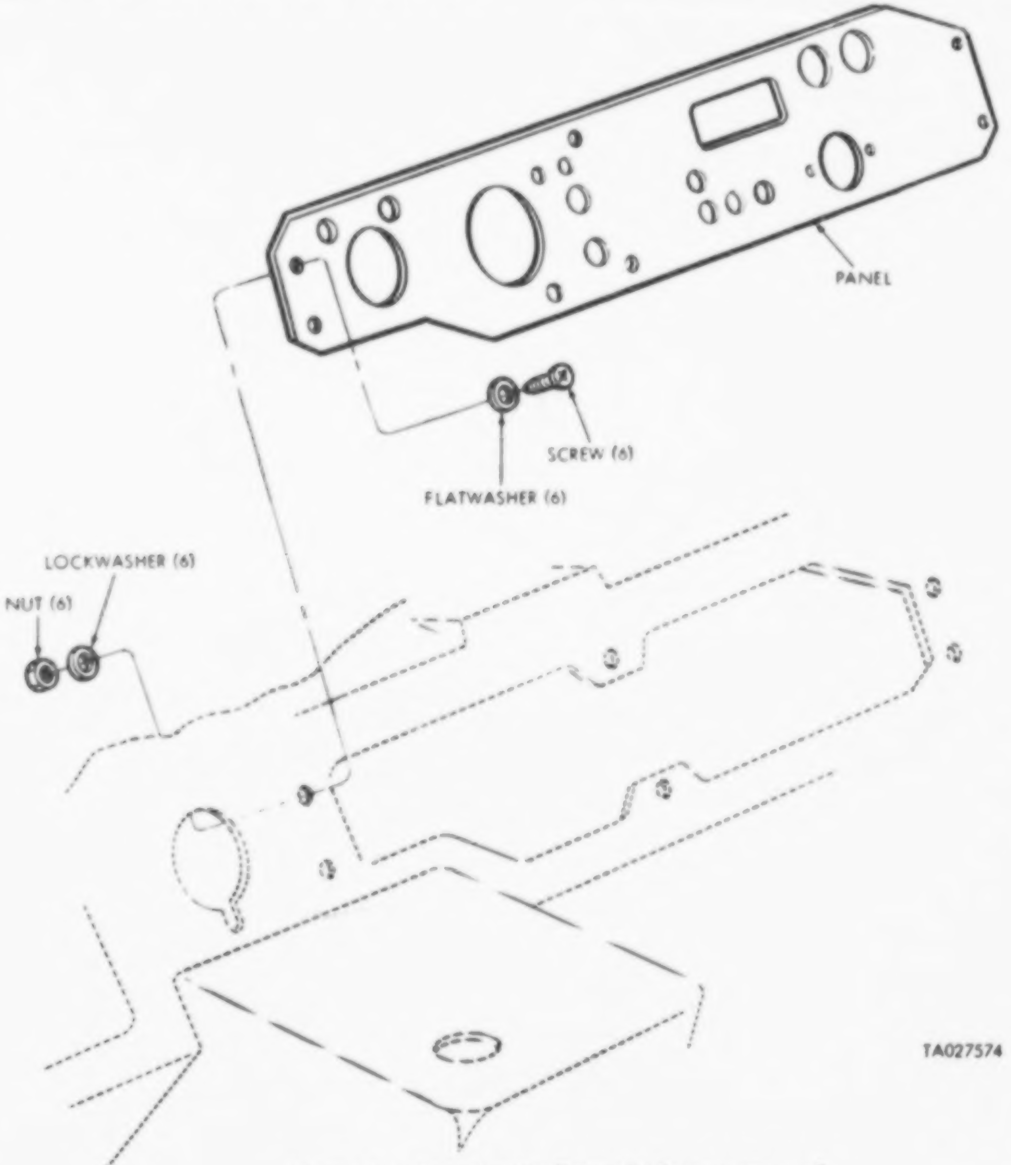


Figure 2-106. Removal or installation of right instrument panel.

and two washers (8) from right side stud.

(2) *Installation.* Install nut, lockwasher, and two washers (8) on right side stud. Install nut, lockwasher, ground terminal, lockwasher, and washer from left side stud. Connect electrical receptacle J6 and connector (circuit 400) behind and below personell heater control box assembly (13).

g. Relay Assembly (fig. 2-105).

(1) *Removal.* Disconnect relay lead to starter switch and connector on circuit wire 14. Unsolder relay lead to ether start switch and remove connection at relay wire going to panel electrical ground. Remove two screws, lockwashers, and nuts (20) securing relay (21) to instrument panel mounting bracket. Remove relay.

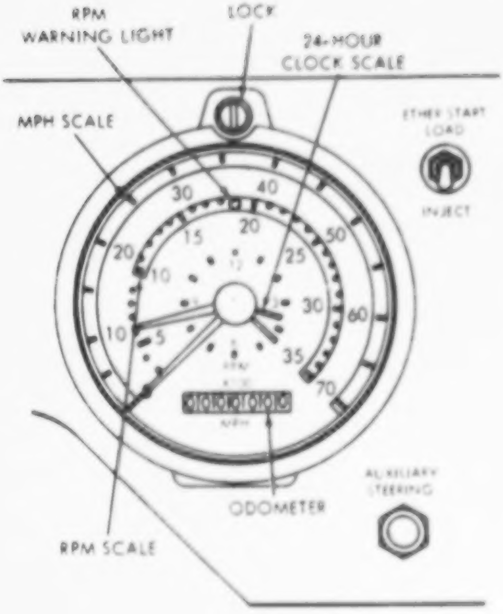
(2) *Installation.* Position relay (21) on instrument panel mounting bracket and secure by installing two screws, lockwashers, and nuts. Solder relay lead to ether start switch and install connection at relay wire going to panel electrical ground. Connect relay lead to starter switch and connector on circuit wire 14.

h. Instrument Panel (fig. 2-106).

NOTE

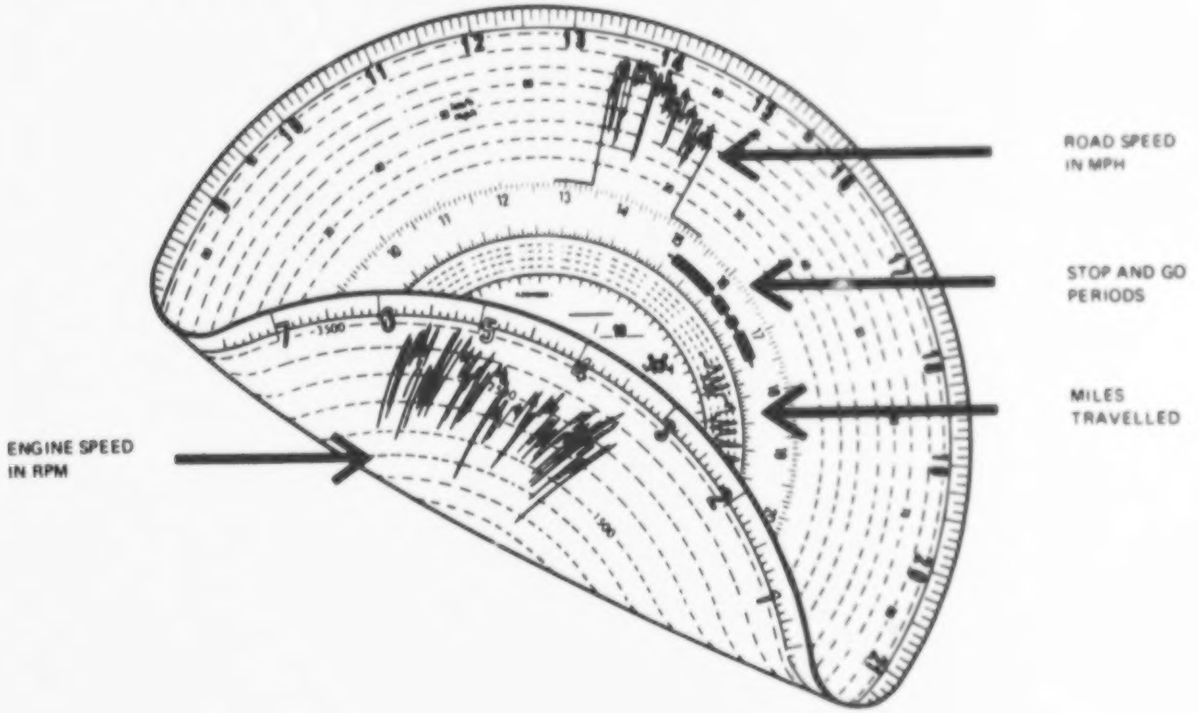
Disconnect electrical cables before removing instrument panel.

(1) *Removal.* Remove six screws, washers, lock-


RPM WARNING LIGHT
LOCK
24-HOUR CLOCK SCALE
MPH SCALE
ETHER START LOAD
INJECT
AUXILIARY STEERING
ODOMETER
RPM SCALE

TA027798

Figure 2-107. Instrument cluster panel with tachograph—front view.


ROAD SPEED IN MPH
STOP AND GO PERIODS
MILES TRAVELLED
ENGINE SPEED IN RPM

TA 001803

Figure 2-108. Tachograph chart.

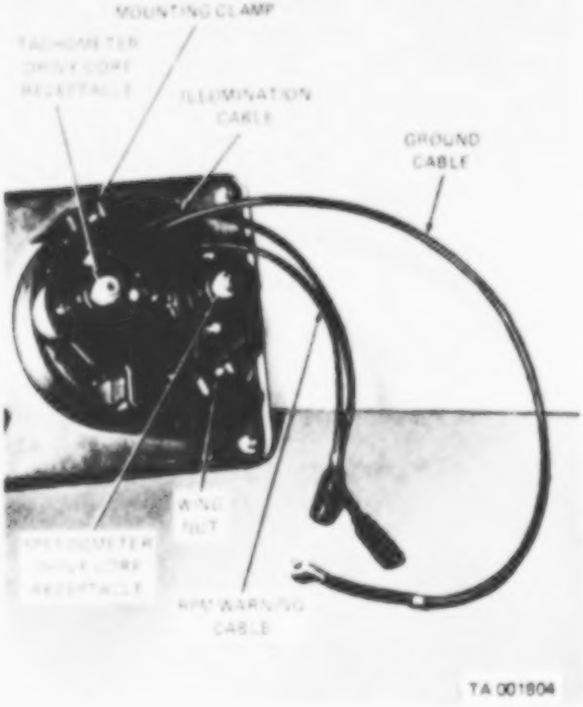


Figure 2-109. Instrument cluster with tachograph—rear views.

washers, and nuts securing panel assembly to cab. Pull panel assembly away from cab.

(2) Installation. Assemble instrument panel to cab by installing six screws, lockwashers, washers, and nuts.

2-76. Tachograph

a. Description

(1) The tachograph is located on the instrument cluster which is mounted in the instrument panel (fig. 2-105). It is used in lieu of individual speedomenter and tachometer. The tachograph is a combination instrument incorporating a speedometer, tachometer, odometer, engine revolution counter, and a 24 hour clock, all in one unit (fig. 2-107). The clock is spring wound and rotates a paper chart (disk) (fig. 2-108) past a number of styluses which record vehicle speed, engine rpm, and stop-and-go periods on a 24 hour basis. A warning lamp at upper center of rpm scale illuminates at 2,600 rpm to indicate overspeeding the engine. Illumination of tachograph dial is provided by two lamps contained within the unit (fig. 2-109). The speedometer and tachometer drive shafts are both connected to a single instrument instead of separate instruments. There are four recording styluses in the tachograph: A road-speed stylus, an engine rpm stylus, a stop-and-go stylus, and a distance traveled stylus. The stop-and-go stylus is a vibrating type, which makes a record on the moving chart indicating whether vehicle is standing still or moving.

(2) To prevent unauthorized personnel from tampering with the tachograph, it has a lock and key, with a knife in the door that notches the chart each time door is closed. Disconnecting either of the drive shafts leaves the various styluses to draw an undeflected base line; however, the stop-and-go stylus still records the fact that vehicle has been operated. Putting a weight or a rubber band on the speed stylus deforms its markings in a telltale way. Bending the stylus makes it record below zero when vehicle is standing still. The recordings are indelible: even grease on the chart can be washed off with gasoline without affecting the recorded pattern.

b. Operating the Tachograph (fig. 2-110).

(1) Fill in all information required to center portion of each side of new chart.

(2) Open instrument by turning key to the left; use key as a handle.

(3) Insert new chart observing the following procedures:

(a) Lift clamping lever of accurate time positioning device.

(b) Insert green printed side of chart toward inside of instrument, that is, facing the person installing the chart.

(c) Place edge of chart under rpm coupling.

(d) Close clamping lever.

NOTE

Insert a new chart every day before starting, or whenever vehicle operator is changed. Charts left in an instrument for several days make it impossible to analyze recordings, since several day's registration overlap.

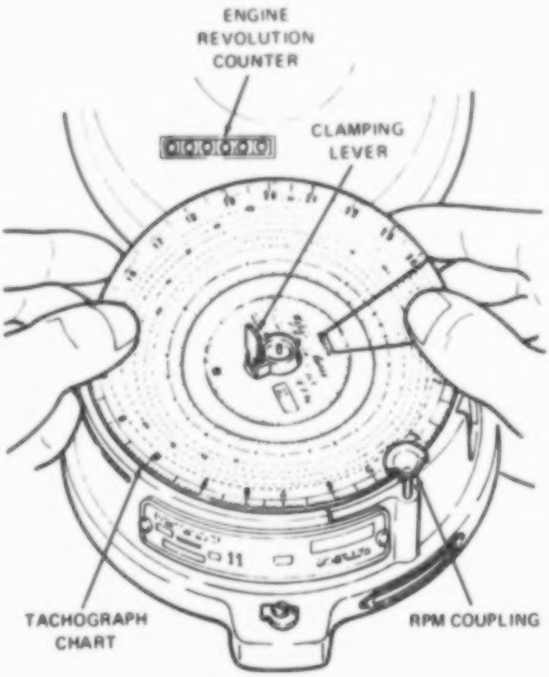


Figure 2-110. Installing tachograph chart.

CAUTION

Do not operate tachograph with cover in closed position without a chart, as damage will result to the styluses.

NOTE

When new charts are not available, insert a used chart and operate vehicle in this manner until new charts become available. Insert only charts with a speed range corresponding to that of the instrument in use, or false readings will result.

(e) Handle and store charts carefully. Do not fold or scratch them. Do not write in the recording fields. Handle accident charts with special care, due to their value as legal evidence.

(4) Wind clock by moving winding lever to and fro until it strikes the stop (fig. 2-111). The clock should be wound each time a new chart is inserted.

(5) Set clock by turning chart support (fig. 2-111) to the left rough setting; final setting is made by using the lateral hand wheel. Use numerals on chart support as a reference, the arrow marks clock time.

c. Tachograph Adjustments.

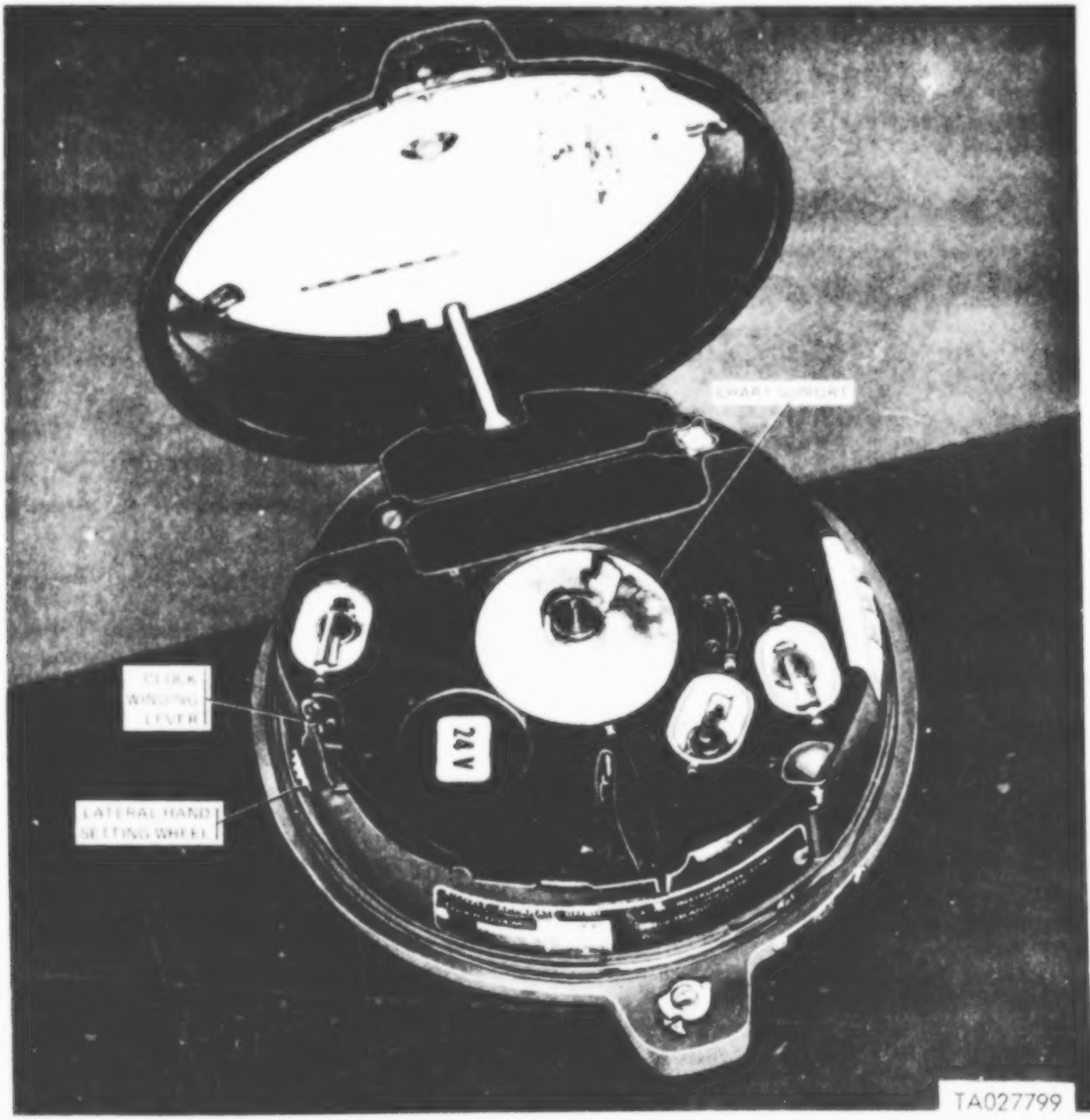


Figure 2-111. Tachograph chart control

(1) *Adjusting stop and go vibration stylus.* Turning adjusting screw right; stylus moves upward. Turning adjusting screw left; stylus moves down. Stylus is correctly adjusted when base line extends from the center of broad band (fig. 2-112).

(2) *Adjusting engine rpm warning contact.* Turning adjusting screw to right; warning at higher rpm. Turning adjusting screw to left; warning at lower rpm (fig. 2-112).

(3) *Adjusting clock movement.* If clock is losing time, move adjusting lever on inside of cover toward plus (+); if clock is gaining time, move adjusting lever toward minus (-) (fig. 2-113).

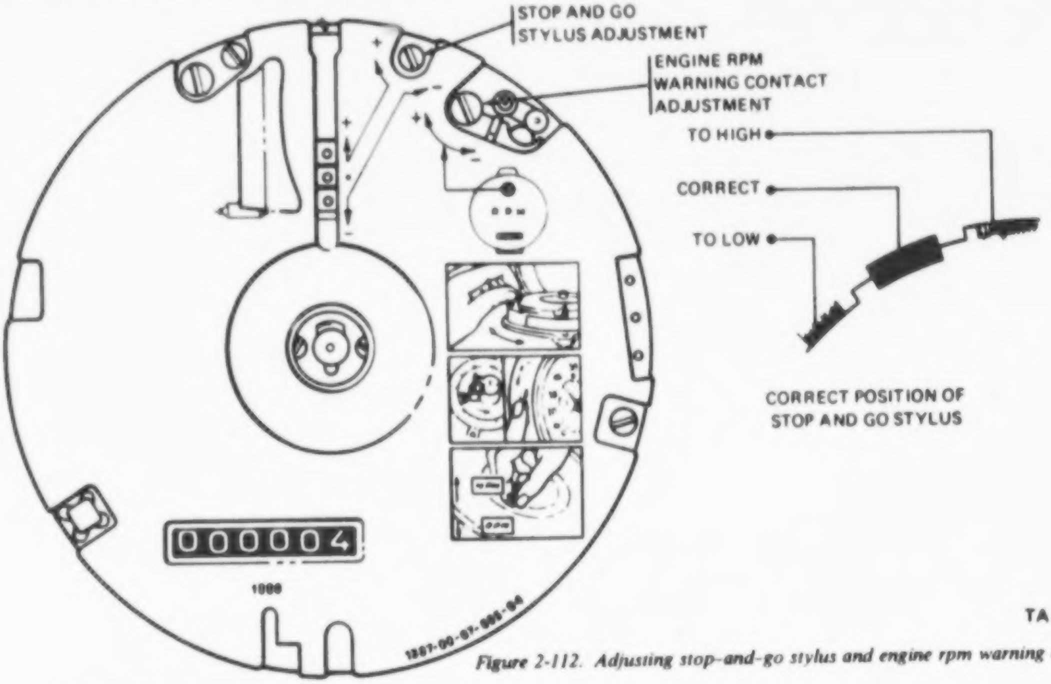

STOP AND GO
STYLUS ADJUSTMENT
ENGINE RPM
WARNING CONTACT
ADJUSTMENT
TO HIGH
CORRECT
TO LOW
CORRECT POSITION OF
STOP AND GO STYLUS
000004
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Figure 2-112. Adjusting stop-and-go stylus and engine rpm warning contact.

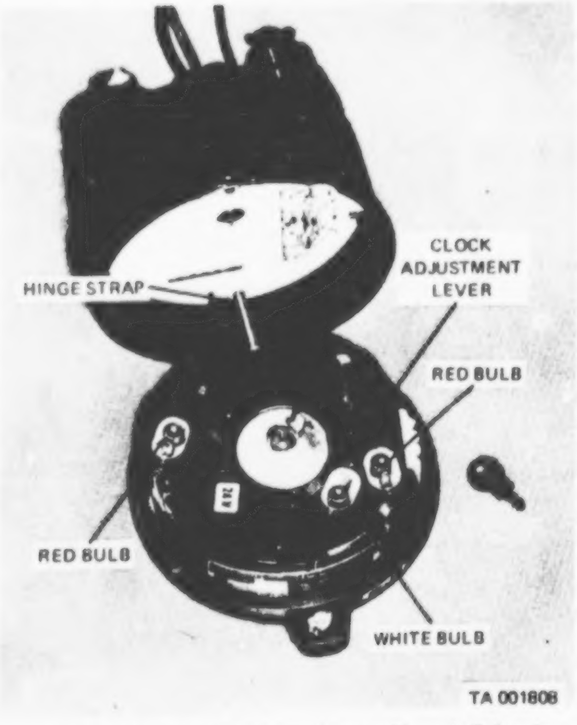

HINGE STRAP
CLOCK
ADJUSTMENT
LEVER
RED BULB
RED BULB
WHITE BULB
TA 001808

Figure 2-113. Clock adjustment lever and lamp bulb locations.

d. Removal of Tachograph. Disconnect three electrical connectors (circuits 27, 40A, 685) from rear of tachograph (1) (fig. 2-105). Remove screw and two lockwashers (4) securing tachograph ground lead to instrument panel. Place hand in front of tachograph to prevent instrument from falling and remove two wingnuts and lockwashers. Remove tachograph from front instrument panel. Remove two shafts from tachograph.

e. Installation. Install two shafts in tachograph. Position tachograph on front of instrument panel. Place hand in front of tachograph to prevent instrument from falling and install two wingnuts and lockwashers. Position tachograph ground lead to instrument panel and secure by installing screw and two lockwashers (4). Connect three electrical connectors (circuits 27, 40A, 685) to rear of tachograph.

CAUTION

Do not operate tachograph without tachograph chart, as damage will result to styluses. When new charts are not available, use an old chart to protect mechanism while vehicle is operating.

f. Replacement of Lamp Bulbs.

(1) Open front of tachograph unit with locking key

(fig. 2-113) and remove tachograph chart to expose lamp sockets.

(2) Lift hinged brass strap securing each lamp bulb and remove bulb.

(3) Install new lamp bulb into socket and secure by closing and snapping brass strap into locked position.

(4) Install tachograph chart properly and close cover and lock with key.

2-77. Tachograph Charts

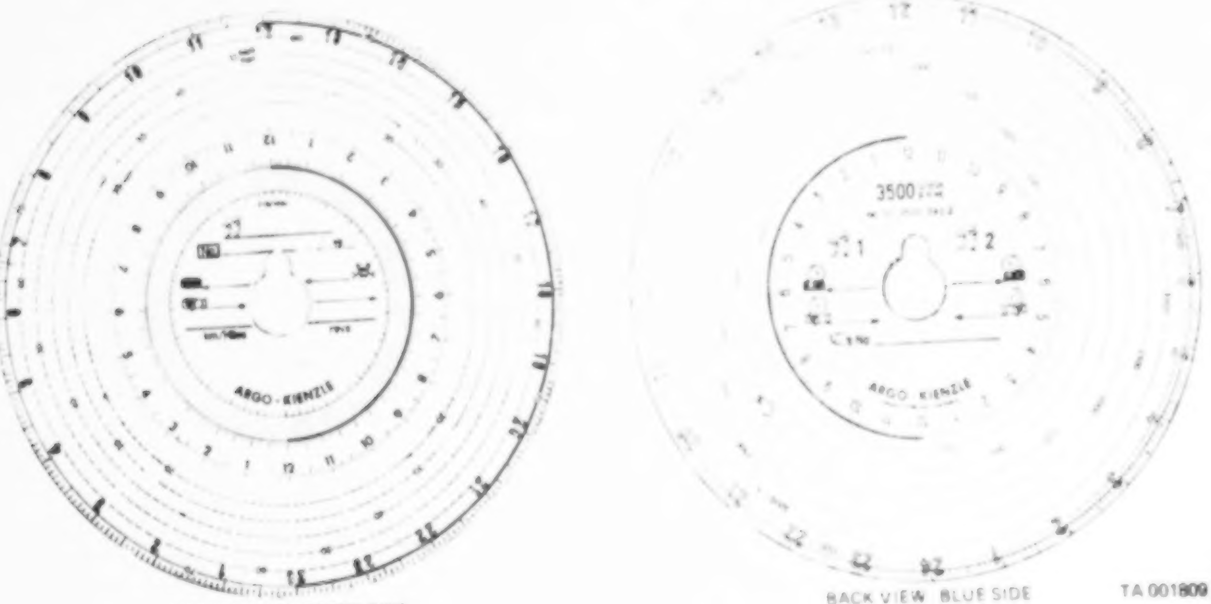
a. Description. The chart consists of a strong red backing paper covered on both sides with a thin wax coating. Each tachograph stylus cuts a groove in the recording layer to reveal the red backing paper, thus producing desired recording. The chart is divided into recording fields by markings which enable numerical values to be read (fig. 2-114). The recording field printed on front side is green; the field printed on reverse side is blue. It is not possible to alter or remove the stylus recordings without damaging the wax surface of the chart. The clock mechanism rotates the chart at a uniform speed so that recordings are related to time. One revolution of chart takes 24 hours to complete.

NOTE

The charts must be changed just **before or** immediately after they have completed [illegible] tation; otherwise new recordings will be superimposed on old recordings.

b. Tachograph Chart Division.

(1) *On the chart.* Four independent values are recorded: vehicle speed, stop and go periods, distance traveled, and engine rpm. Once the chart has been inserted in the instrument and the cover closed, the various styluses begin to record. Additional time scales in the individual recording fields make it possible to read off these values against their respective recordings. The time scales have five minutes graduations (fig. 2-115).



FRONT VIEW GREEN SIDE

BACK VIEW BLUE SIDE

Figure 2-114. Front and back view of tachograph chart.

(2) *Inner field.* Whenever a new chart is installed, fill in all information required in inner field on each side of chart. On front side, enter driver's name, date, beginning odometer, and engine revolution counter readings. On back side of chart, enter vehicle number and starting time. At end of trip or change of driver, record final odometer and engine revolution counter readings and ending time. Careful entry of all items will save unnecessary inquiries when charts are evaluated.

(3) *Vehicle speed field.* The speed field of the chart is divided up by concentric circles which show how fast vehicle was driven. During acceleration, speed recording stylus moves upward. When vehicle is not moving, a concentric base line is recorded. The base line must run at a predetermined radius otherwise recording will not correspond to actual vehicle speed. Figure 2-116 shows correct position of the base line. If the base line lies below position shown, it is possible that the stylus was bent down to indicate vehicle was driven more slowly than it really was.

(4) *Stop-and-go field.* The stop-and-go field consists of a concentric time scale below which the stop and go stylus records vehicle traveling and stopped times. The recording mechanism consists of a single oscillating pendulm kept in balance by a spring. When vehicle is in motion, vibrations of the pendulum are transmitted to the stylus, which is deflected through a given width. An

extended journey takes the shape of a broad red band, while stop times register as a thin red line. The vibrating pendulum is a simple form of seismograph which records all vibrations of vehicle independently of the tachograph drive mechanism. This recording will remain unaffected by a faulty driver mechanism or a broken or disconnected cable (fig. 2-117).

(5) *Distance recording field.* The distance recording field is divided by five concentric circular lines: the distance between each line corresponds to exactly one mile of travel. The distance stylus registers distances covered with respect to the time run. One complete upward and downward cycle corresponds to ten miles. Pauses between distances are registered as the arc of a circle (fig. 2-118).

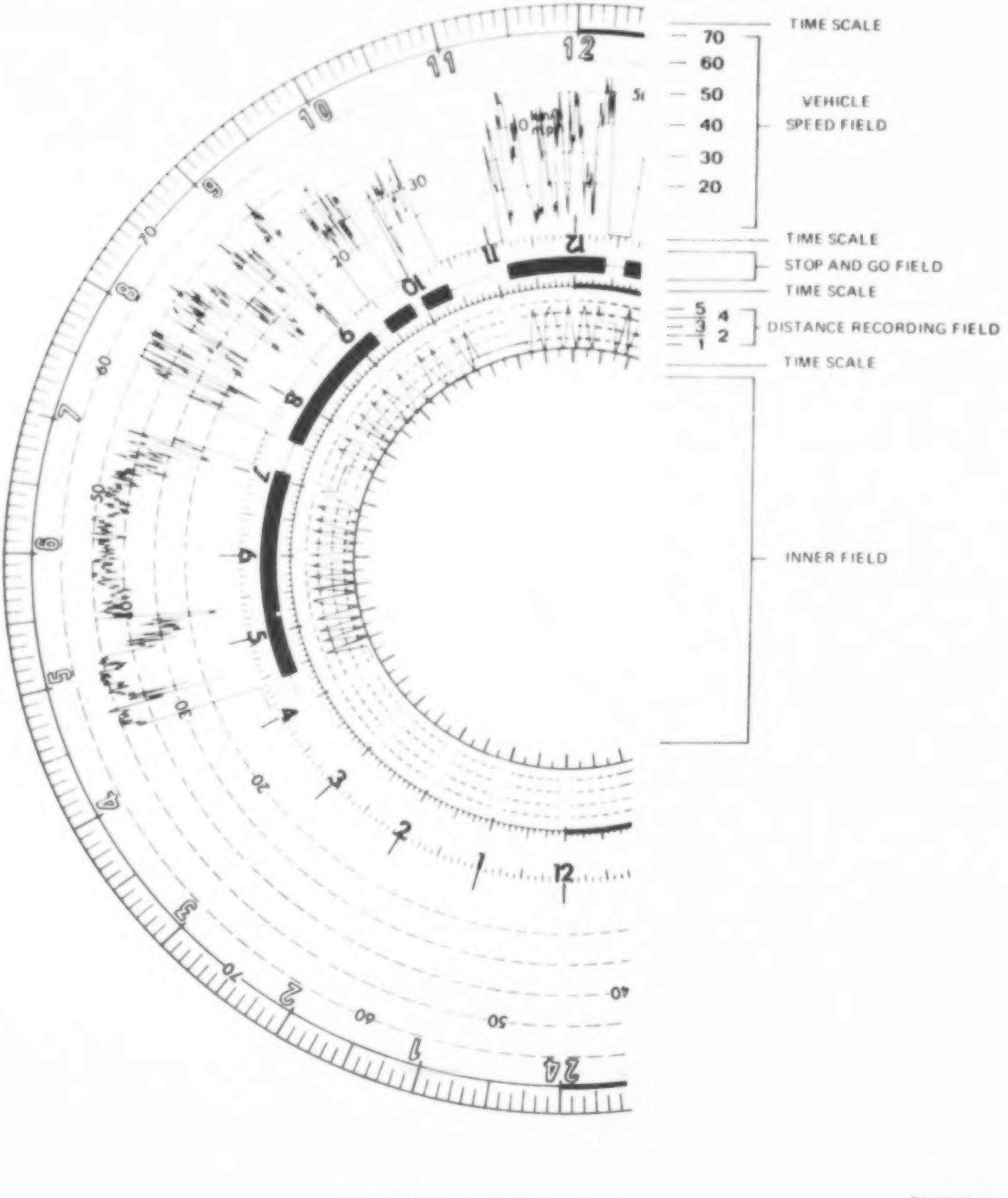

TIME SCALE
70
60
50
40
30
20
VEHICLE SPEED FIELD
TIME SCALE
STOP AND GO FIELD
TIME SCALE
5
4
3
2
1
DISTANCE RECORDING FIELD
TIME SCALE
INNER FIELD
12
11
10
9
8
7
6
5
4
3
2
1
24

Figure 2-115. Tachograph chart division.

TA 001810

(6) *Engine rpm field.* Engine rpm is recorded on reverse side of chart at same time as vehicle speed, stop and go periods, and distances traveled. The recording field for engine rpm is also divided by concentric circles, which enable the reviewer to read accurately rpm reached at any point in time. The recording is not made as a straight line, but as a vertical arc. The time graduation is related to the base line and the maximum rpm measuring range. Unlike the speed diagram, the base line is recorded immediately after inserting chart and not just when cover is closed (fig. 2-119).

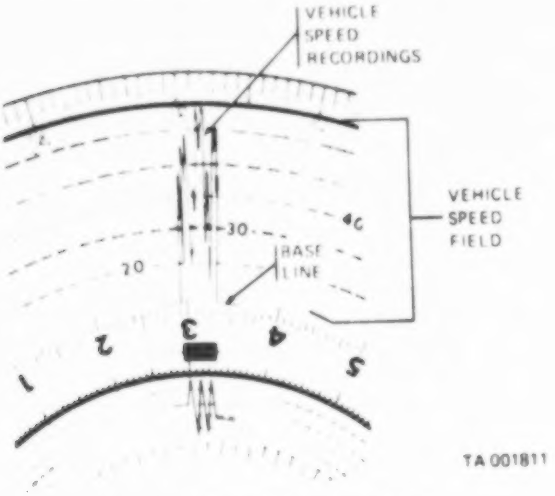

VEHICLE SPEED RECORDINGS
VEHICLE SPEED FIELD
BASE LINE
20
30
40
1
2
3
4
5
TA 001811

Figure 2-116. Vehicle speed recordings.

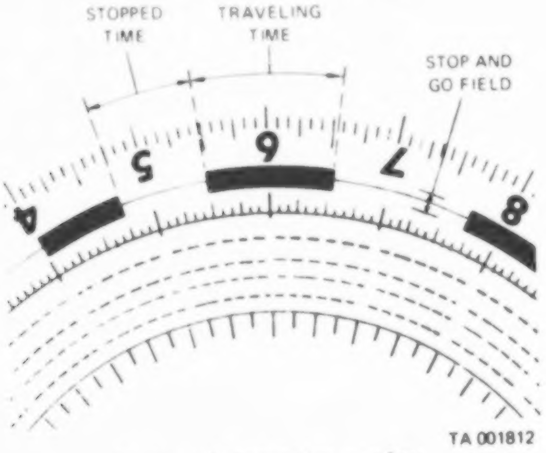

STOPPED TIME
TRAVELING TIME
STOP AND GO FIELD
4
5
6
7
8
TA 001812

Figure 2-117. Stop-and-go recordings.

c. Use of Tachograph Chart as Data Source for Vehicle.

(1) *General.* The chart provides valuable statistical information on driving manner from which essential data for testimony can be obtained. The results of evaluation give answers to questions relating to vehicle use. For example:

(a) Percentage of vehicle utilization.
(b) Number of stops and length of stops.

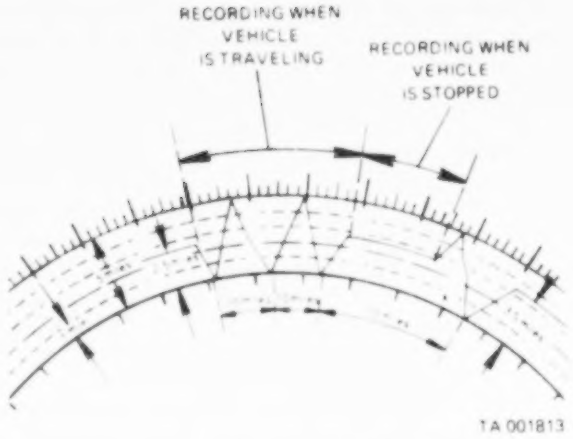

RECORDING WHEN VEHICLE IS TRAVELING
RECORDING WHEN VEHICLE IS STOPPED
TA 001813

Figure 2-118. Distance traveled recordings.

(c) Excessive speed.
(d) Excessive engine idling.
(e) Correct warm up; correct shut down.
(f) Driving in proper rpm range.
(g) Over speeding engine.
(h) Lugging engine.
(i) Total engine rpm compared to total miles.

The tachograph automatically provides information on all these factors on the chart. The readings have only to be correctly evaluated.

(2) *Time range for evaluation.* The extent and time required for evaluation depends on data to be processed. A detailed operational analysis need not be carried out over the whole year. Evaluation can be made over an uninterrupted period of about one month, then extrapolated over the year to figure degree of utilization of a vehicle. For a thoroughly detailed analysis using auxiliary devices, a time of one to two minutes per chart is required.

(3) *Working times.* The chart is inserted at start of duty hours. The beginning and end of the recordings

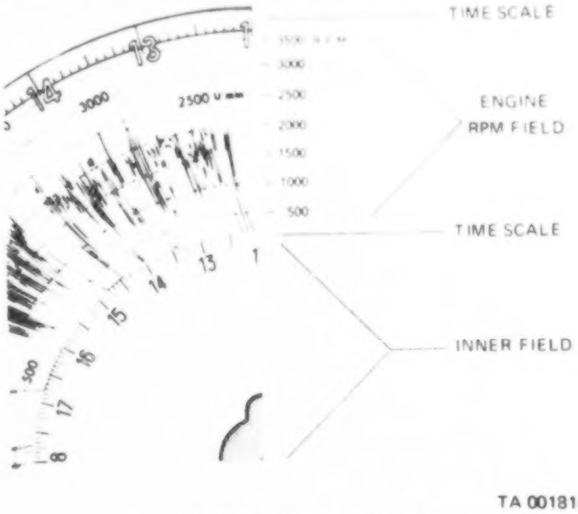

TIME SCALE
ENGINE RPM FIELD
TIME SCALE
INNER FIELD
3000
2500
2000
1500
1000
500
13
14
15
16
17
TA 001814

Figure 2-119. Engine rpm readings.

must correspond with those hours. By adding up partial times marked by red band of stop-and-go stylus, exact length of driving time during duty hours can be determined. The thin line recordings indicate pauses or breaks.

NOTE

Insure that vehicles are not used without permission after duty hours.

(4) *Traveling periods.* Traveling time is seen from the broad band of stop-and-go recordings and corresponds to time spent at the wheel. Total time traveled can be determined by adding up the time periods corresponding with the broad bands; it is important in calculating average speed and determining driving manner.

(5) *Stopped periods.* A thin concentric line registered by stop-and-go recorder denotes a stationary vehicle. The stopped time can be determined by adding up time periods indicated by the thin lines. In the case of primary local use, there may be considerable stopped time. Some reasons for long stationary periods are:

(a) Loading and unloading.
(b) Waiting at a loading space.
(c) Repairs, servicing, refueling.
(d) Pauses in work.

(6) *Degree of utilization.* Degree of utilization is the ratio of traveling time to total operating time.

$$\text{Degree of utilization} = \frac{\text{Traveling time}}{\text{Total time}} \times 100$$

Vehicle load should also be taken into account when computing degree of utilization.

(7) *Average speed.* Average speed is calculated from data taken from the chart.

$$\underset{\text{(MPH)}}{\text{Average speed}} = \frac{\text{Miles traveled}}{\text{Actual driving time (min)}} \times 60$$

(8) *Applicable speed limits.* For certain types of vehicles, maximum speeds are prescribed by law. Check chart from time to time to see that these laws are actually being observed.

(9) *Distance traveled in miles.* Distance covered is found from visible distance counter and from chart notations. The mileage counter section of distance recorder counts all miles traveled, even when tacograph is ope The day's journey or any partial journey can be determined from chart. At start and at end of journey, distance recorder figures must be entered in inner field of chart. The difference between the two values must coincide with distance recorded on chart, otherwise the entries have been falsified or instrument has been left open.

d. Analyzing the Tachograph Chart.

(1) *General.* Practical experience and experiments show that a vehicle driver has considerable influence on the economical operation of his vehicle. The tachograph chart shows when the manner of driving is good or when it is poor, and requires improvement. The chart may be evaluated simply by examining speed and engine rpm recordings. This is best accomplished on a daily basis. The following typical charts illustrate some common driving characteristics which may be identified. In general, good driving is characterized by uniform driving and moderate speeds. The closer the maximum speed approaches the average speed, the more uniform and economical is the manner of driving.

(2) *Good driving and bad driving.* High needle-shaped speed peaks should be avoided as far as possible. They show that a vehicle has been accelerated unnecessarily, requiring it to be braked again almost immediately. This indicates bad driving and is often the reason why a vehicle has a shorter useful life. When evaluating charts, type of use and road traffic conditions must be taken into account. Figures 2-120 and 2-121 demonstrate good and bad driving charts, respectively.

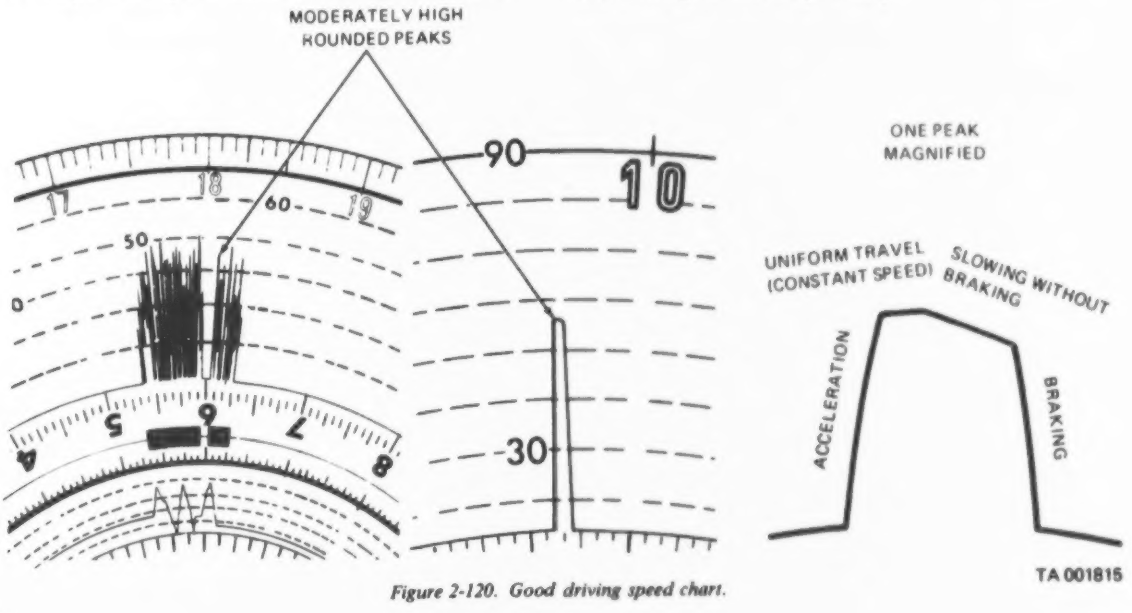


Figure 2-120. Good driving speed chart.

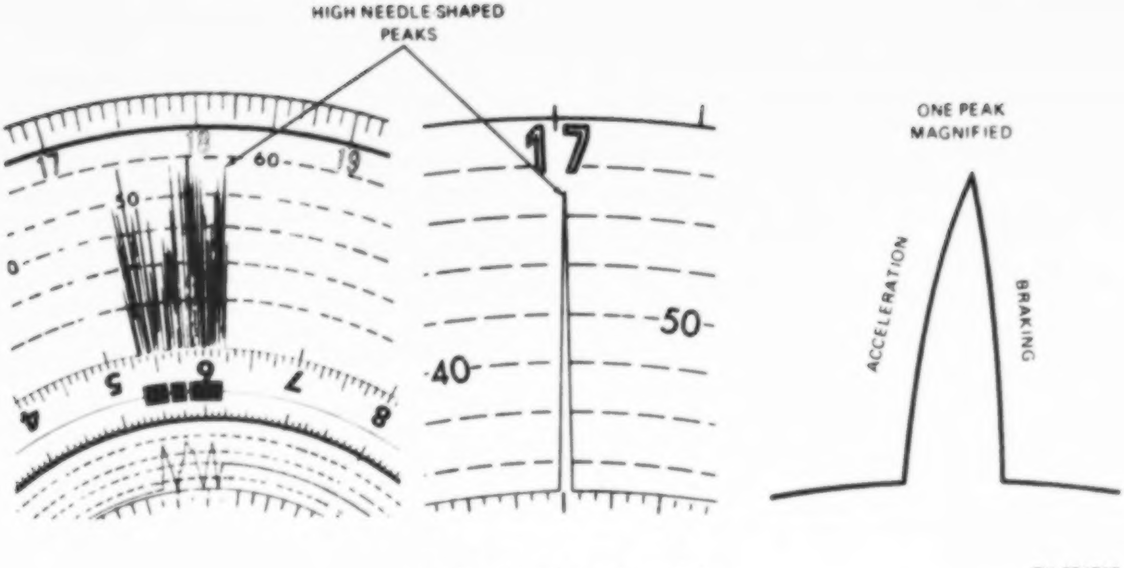


Figure 2-121. Bad driving speed chart.

(3) *Good driving and bad driving over short distances.* Analyzing speed traveled alone will not reveal correct vehicle operation, particularly in the case of heavy vehicles used over short distances in heavy traffic. Despite speed limits and traffic conditions, the driver has considerable influence over the proper running of his vehicle. Two different drivers traveling over the same route can have nearly identical speed charts, yet widely different qualities of driving and economy. Only when speed traveled is used in conjunction with engine rpm, can correct vehicle operation be determined. The charts in figure 2-122 show in each case two trips on a normally scheduled route showing two trips with economical driving and two trips with uneconomical driving. To the experienced eye, there is hardly any difference between the respective speed recordings. On the other hand, the rpm recordings reveal the characteristic features of both types of driving. While in one case rpm has been used onlywithin an economic range, in the other case the engine has run at maximum rpm in the individual gears. There is a difference in journey time of only two percent.

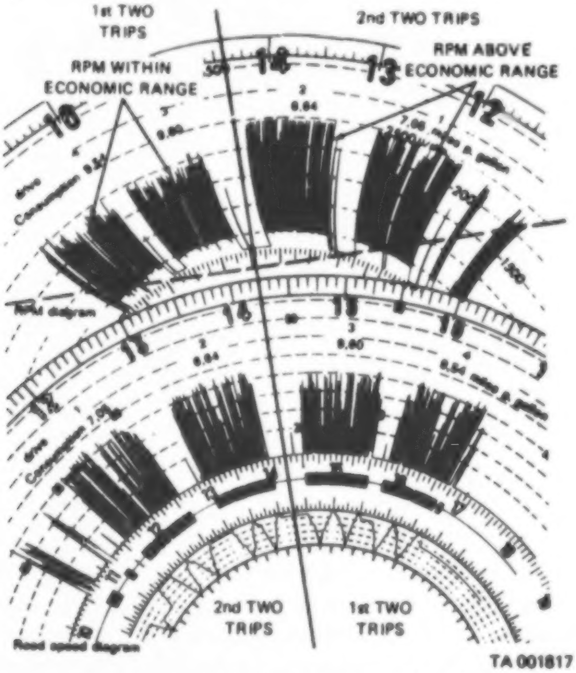


Figure 2-122. Good and bad driving over short distances.

(4) *Driving downhill without gear engaged.*This can be recognized from the fact that individual speed peaks extended above maximum speed specified in operating instructions for the vehicle. At the same time, the rpm diagram shows engine idling. If engine were coupled to the wheels, rpm would increase with speed of travel (fig. 2-123).

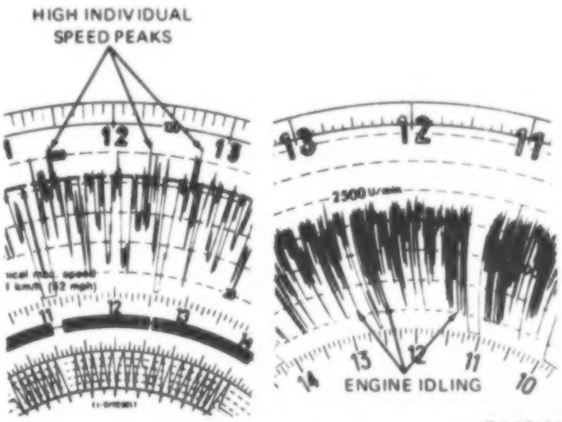


Figure 2-123. Driving downhill without gear engaged.

(5) *Driving uphill in wrong gear.* The speed chart alone (fig. 2-124) does not lead to any conclusion as to which gear was engaged. But the rpm chart shows that engine was overloaded at low rpm. Damage to engine is often the result of such handling. Correct operation with rpm in the region of maximum torque is illustrated in figure 2-125.

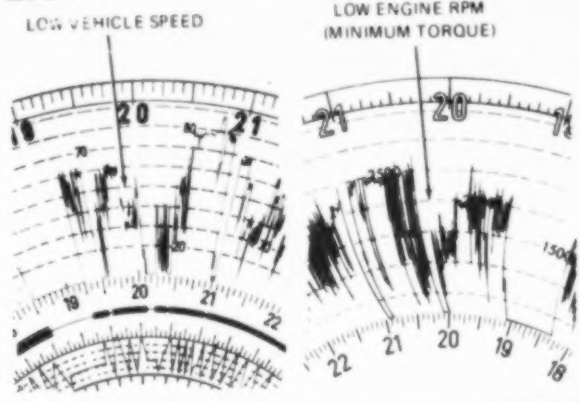


Figure 2-124. Driving uphill in wrong gear.

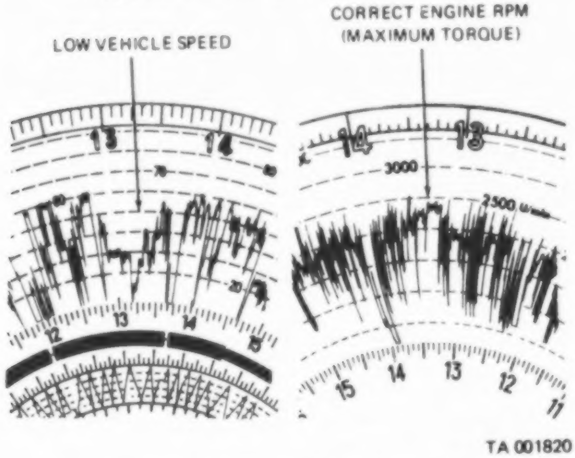


Figure 2-125. Driving uphill in correct gear.

(6) *Traveling downhill in wrong gear.* The speed of travel varies constantly as a result of acceleration caused by vehicle weight. When service brake is applied, heavy stress on it and transmission components results. The rpm chart also reveals constant alternation between high and low rpm. The engine can easily be run at excessively high rpm (fig. 2-126).

(7) *Engine run at excessively high rpm.* The speed chart does not reveal this fault in driving. On the other hand, it can be seen clearly from the rpm chart that the permissible maximum rpm is constantly being exceeded (fig. 2-127).

(8) *Engine idling.* The rpm chart clearly shows unnecessary running of engine for a period of several hours. Excessive engine idling is indicated by the recording of low engine rpm for periods of several minutes or hours while at the same time no vehicle travel is indicated on the speed chart (fig. 2-128).

(9) *Cold starting and warming up the engine.* The chart in figure 2-129 shows that the engine was accelerated to maximum rpm immediately after cold starting. This procedure can cause damage to pistons and other parts of the engine. On the other hand, recording of idling for several minutes before operating vehicle points to the fact that the engine has been warmed up (fig. 2-130). Speed recording does not begin until after this warm-up.

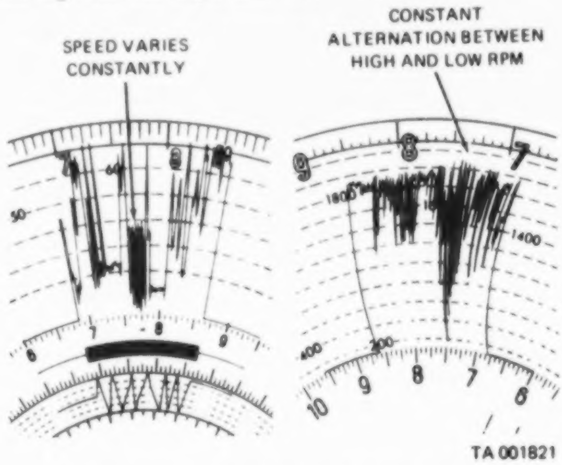


Figure 2-126. Driving downhill in wrong gear.

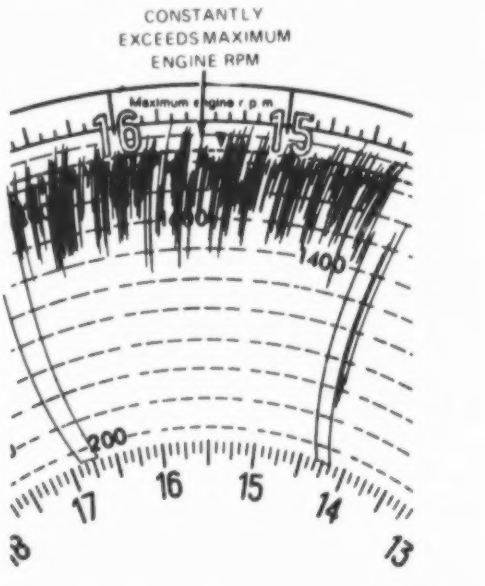


Figure 2-127 Engine run at excessively high rpm

e. Falsification and Irregularities.

(1) *General.* Certain recordings may seem impossible to explain from information given up to now. The cause may be an intentional or unintentional interference by operator, or a defective instrument. The spec-

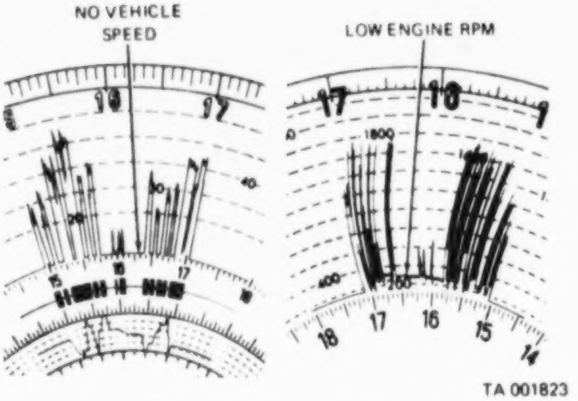
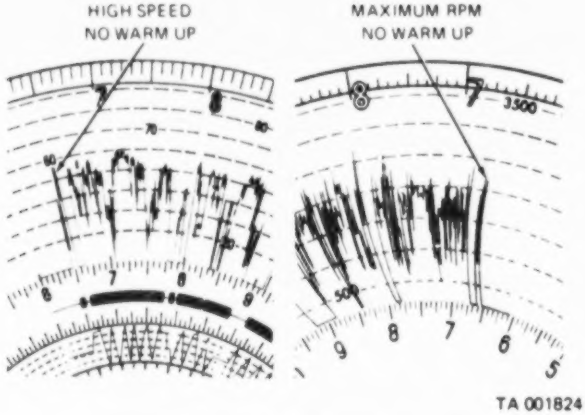

NO VEHICLE SPEED
LOW ENGINE RPM
TA 001823

Figure 2-128. Excessive engine idling.


HIGH SPEED NO WARM UP
MAXIMUM RPM NO WARM UP
TA 001824

Figures 2-129. Poor cold starting procedure.

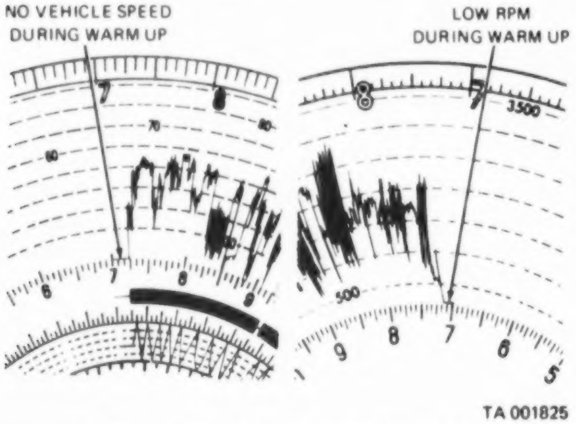

NO VEHICLE SPEED DURING WARM UP
LOW RPM DURING WARM UP
TA 001825

Figure 2-130. Good cold starting procedure.

ial design of the tachograph with its various mechanisms offers a wide range of possibilities for checking through which any irregularity can be ascertained. In practice, falsifications hardly ever occur. However, the following subparagraphs describe areas where possible falsification methods may occur.

(2) *Lowered speed*

(a) Identifying feature. The speed stylus records below prescribed base line.

(b) Cause. Speed stylus bent in order to simulate lower speeds. To find actual speed, add the difference to recorded speed. The instrument must be readjusted (fig. 2-131).

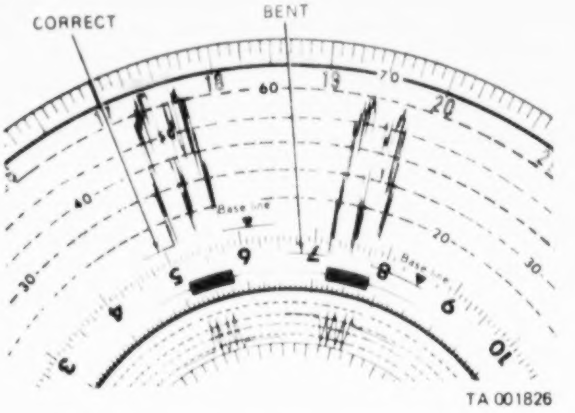

CORRECT
BENT
Base line
Base line
TA 001826

Figure 2-131. Speed stylus bent to simulate lower speeds.

(3) *No deflection of speed and distance styluses.*

(a) Identifying feature. Only the stop and go (vibration) recordings indicate deflection; while speed and distance recordings each appear as the arc of a circle, with no peaks or valleys.

(b) Cause. Drive shaft defective or intentionally disconnected to conceal unauthorized trips. The driving of a trip can still be determined, however, from recordings of the vibration stylus (fig. 2-132).

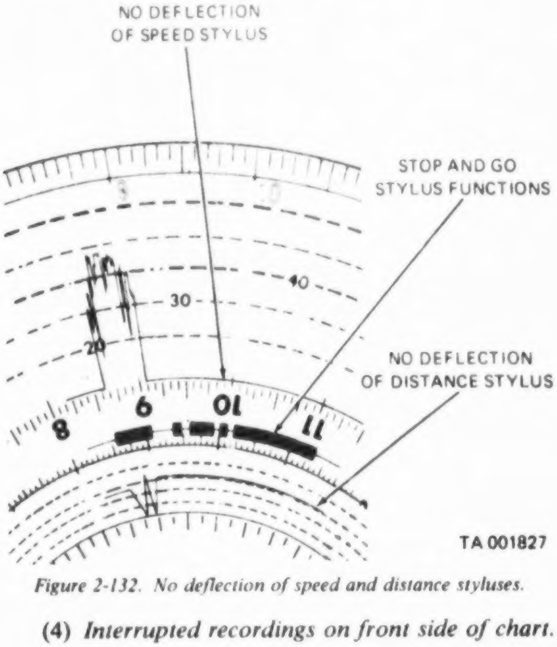

NO DEFLECTION OF SPEED STYLUS
STOP AND GO STYLUS FUNCTIONS
NO DEFLECTION OF DISTANCE STYLUS
TA 001827

Figure 2-132. No deflection of speed and distance styluses.

(4) *Interrupted recordings on front side of chart.*

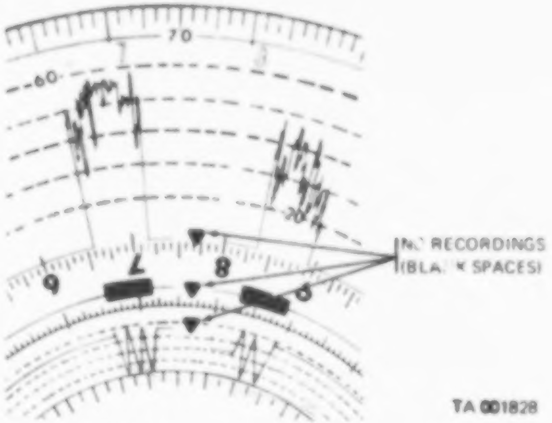
(a) Identifying feature. All recordings on front side of chart are interrupted, leaving a blank interval for

part of trip.

(b) Cause. Instrument cover opened. Blank spaces appear on the chart because recording styluses are not in contact with chart (fig. 2-133). Also determine if final mileage figures coincide with initial figures on next chart (fig. 2-134). If values do not coincide, trips have been made between removal of one chart and insertion of the next one. Also note that time of removal and insertion of chart which is clearly marked. Normally a new chart should be inserted immediately upon removal of used one. If distance does coincide, chart may have been turned backwards to simulate different working times.

(5) *Superimposed recordings.*

(a) Identifying feature. Distance and speed recordings appear to indicate simultaneous stand still and travel.



TA 001828

Figure 2-133. All recordings on front side of chart interrupted.

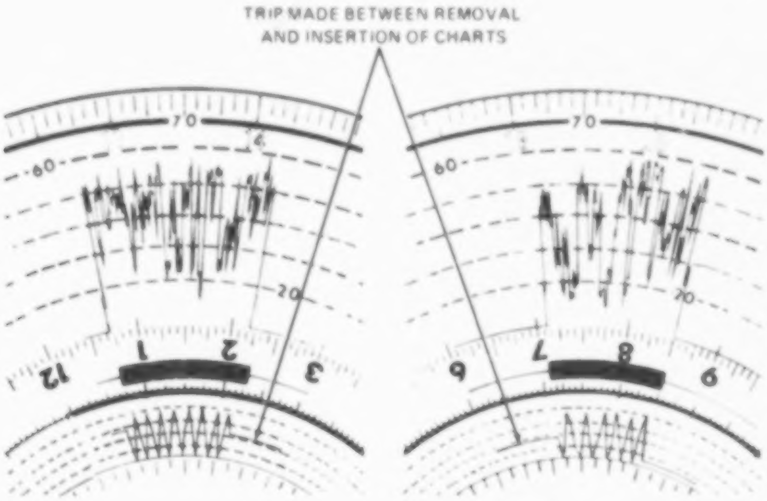


Figure 2-134. Trip made between removal of used chart and insertion of new chart.

TA 001829

(b) Cause.

1. The instrument was opened and the chart turned back in order to conceal unusually long breaks, as shown in detail A (fig. 2-135).

2. The chart was in the instrument more than 24 hours and recordings have consequently been superimposed, as shown in detail B (fig. 2-135). Check time of insertion and removal.

3. Recordings have been filled in by hand, as shown in detail C (fig. 2-135). These differ from those made by the instrument.

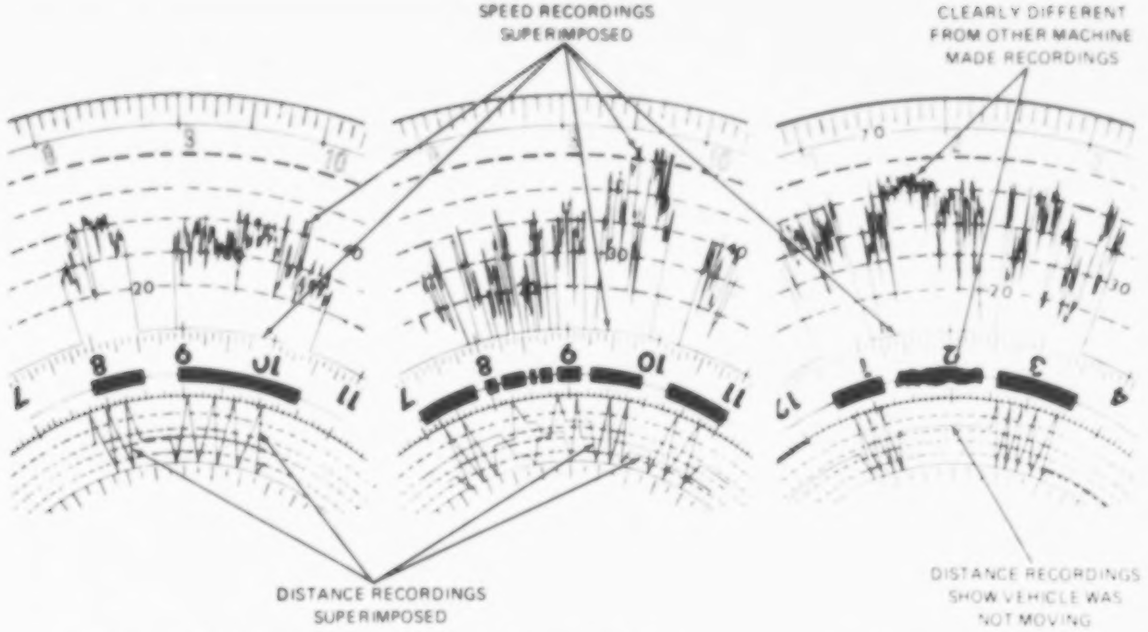
(6) *Long periods of constant speed.*

(a) Identifying feature. The speed recording runs for an unusually long time at a uniform level; constant speeds of this kind are never obtained in practice.

(b) Cause. The speed stylus is prevented from moving upwards by foreign objects being inserted in the instrument to falsely indicate that lower speeds have been maintained. Demonstration of interference is possible by calculating average speed for period of time in question (fig. 2-136). It will usually be found that this appears to be higher than maximum speed of vehicle. The rpm chart should also show similar uniform rpm, but likely will not.

(7) *All styluses give vertical recordings.* The clock mechanism was not wound and remained stationary or else clock mechanism was intentionally blocked. The chart no longer moves and the styluses record in the same position (fig. 2-137).

f. Data Retention. The data generated by the tachograph must be transferred daily from the tachograph chart to DA Form 2408-1. Charts which contain unusual data must be retained at the unit to support actions in connection with equipment improvement recommendations, warranty claims, accidents, etc.


SPEED RECORDINGS SUPERIMPOSED
CLEARLY DIFFERENT FROM OTHER MACHINE MADE RECORDINGS
DISTANCE RECORDINGS SUPERIMPOSED
DISTANCE RECORDINGS SHOW VEHICLE WAS NOT MOVING

A INSTRUMENT OPENED AND CHART TURNED BACK TO CONCEAL UNUSUALLY LONG BREAKS

B CHART LEFT IN INSTRUMENT MORE THAN 24 HOURS

C RECORDINGS FILLED IN BY HAND

TA 001830

Figures 2-135. Superimposed recordings

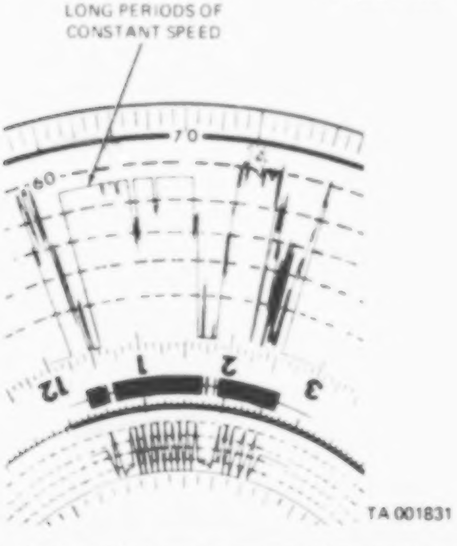

LONG PERIODS OF CONSTANT SPEED
TA 001831

Figure 2-136. Speed recording runs for unusually long period at a uniform level.

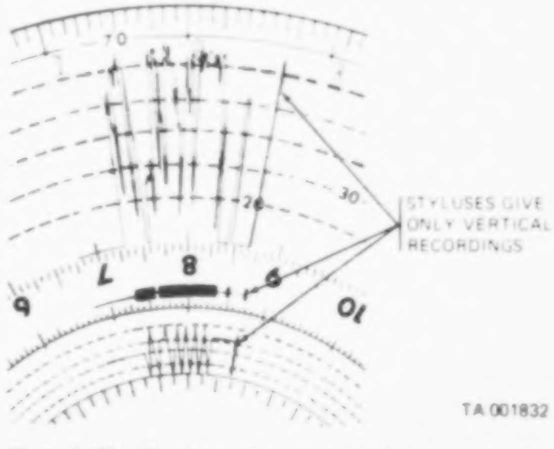

STYLUSES GIVE ONLY VERTICAL RECORDINGS
TA 001832

Figure 2-137. All styluses give vertical recordings due to stoppage

2-78. Circuit Breaker and Relay Panel

Fig. 2-138 and 2-139

NOTE

Panel need not be removed to replace circuit breakers or relays. Care should be taken to prevent mounting screws from being pushed back beyond face of panel. If this happens, remove panel (*b* below).

a. Replacement of components (fig. 2-138).

(1) Disconnect cable assembly (12) electrical connector from circuit breakers CB7 and CB8 (2 and 14).

(2) Remove nut and washer (11) securing cable (12) terminal to blackout relay (16) and remove cable assembly (12).

(3) Disconnect cable assembly (5) electrical connectors from circuit brakers (CB1, CB2, CB3, CB4, CB5, CB9).

(4) Remove nut and washer (6) securing cable terminal to master relay (7) and remove cable assembly (5).

NOTE

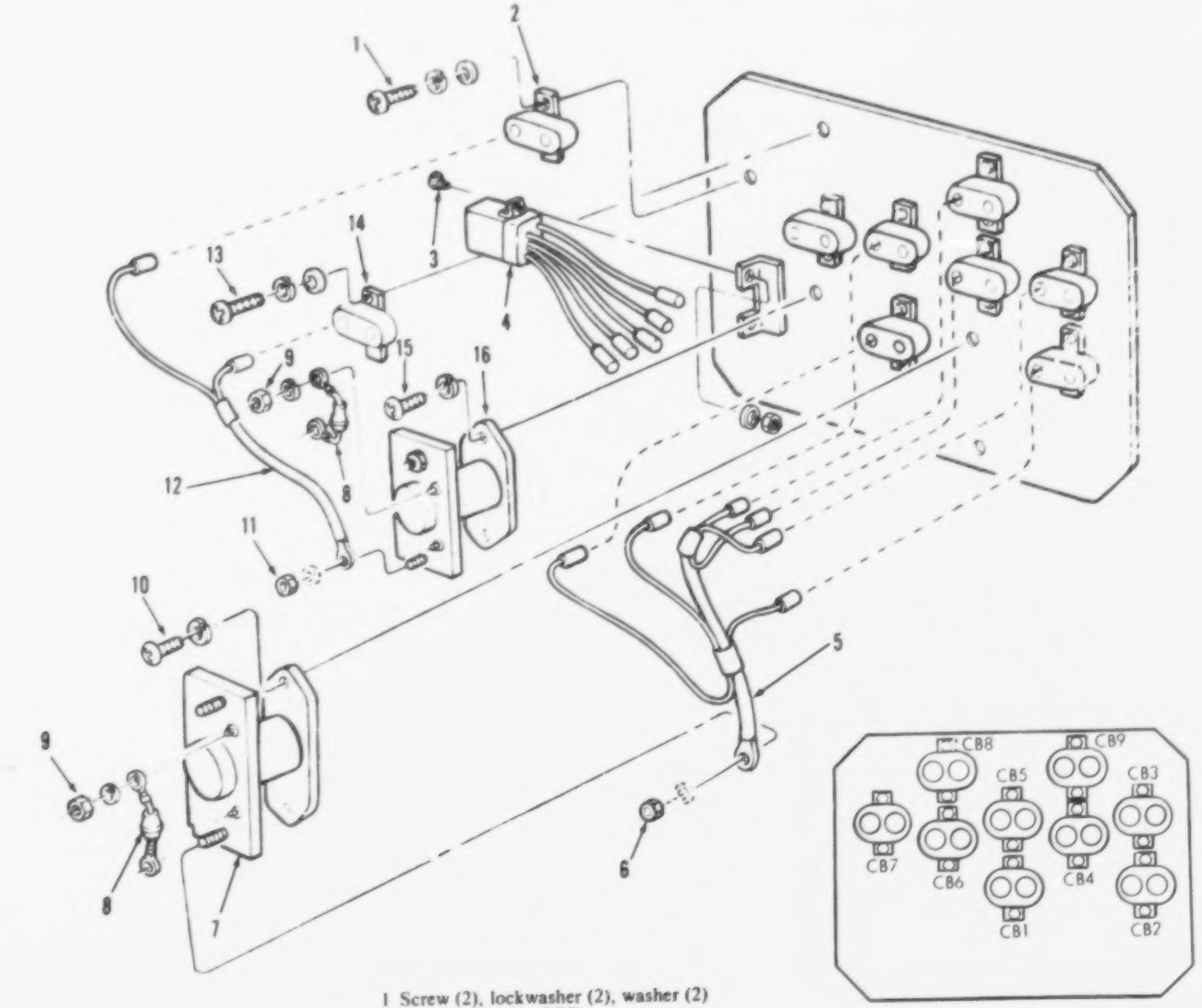
There are nine circuit breakers mounted on the circuit breaker panel. The removal procedures are the same for all circuit breakers.

(5) Remove two screws, nuts, and lockwashers (1) securing circuit breaker to panel and remove circuit breaker.

NOTE

There are three relays (master, blackout, and buzzer) on the circuit breaker panel. The removal procedures are the same for all relays.

(6) Remove two screws, lockwashers, and nuts securing relay to panel and remove relay.



1 Screw (2), lockwasher (2), washer (2)
2 Circuit breaker (CB7)
3 Screw (2), lockwasher (2), nut (2)
4 Buzzer relay
5 Cable assembly
6 Nut, lockwasher
7 Master relay
8 Diode (2)
9 Nut (4), lockwasher (4)
10 Screw (2), lockwasher (2)
11 Nut, lockwasher
12 Cable assembly
13 Screw (2), lockwasher (2), washer (2)
14 Circuit breaker (CB8)
15 Screw (2), lockwasher (2), washer (2)
16 B.O. relay

Figure 2-138. Circuit breaker and relay panel—exploded view.

b. Removal and Installation of Circuit Breaker and Relay Panel (fig. 2-139).

(1) *Removal.* Support panel to prevent falling of panel when screws are removed. Remove ten screws and lockwashers securing cover, gasket, and circuit breaker panel to dash panel. Remove panel, gasket, and cover.

(2) *Installation.* Assemble panel, gasket, and cover together. Install ten (10) screws and lockwashers securing cover, gasket, and circuit breaker panel to dash panel. Support panel to prevent falling during installation.

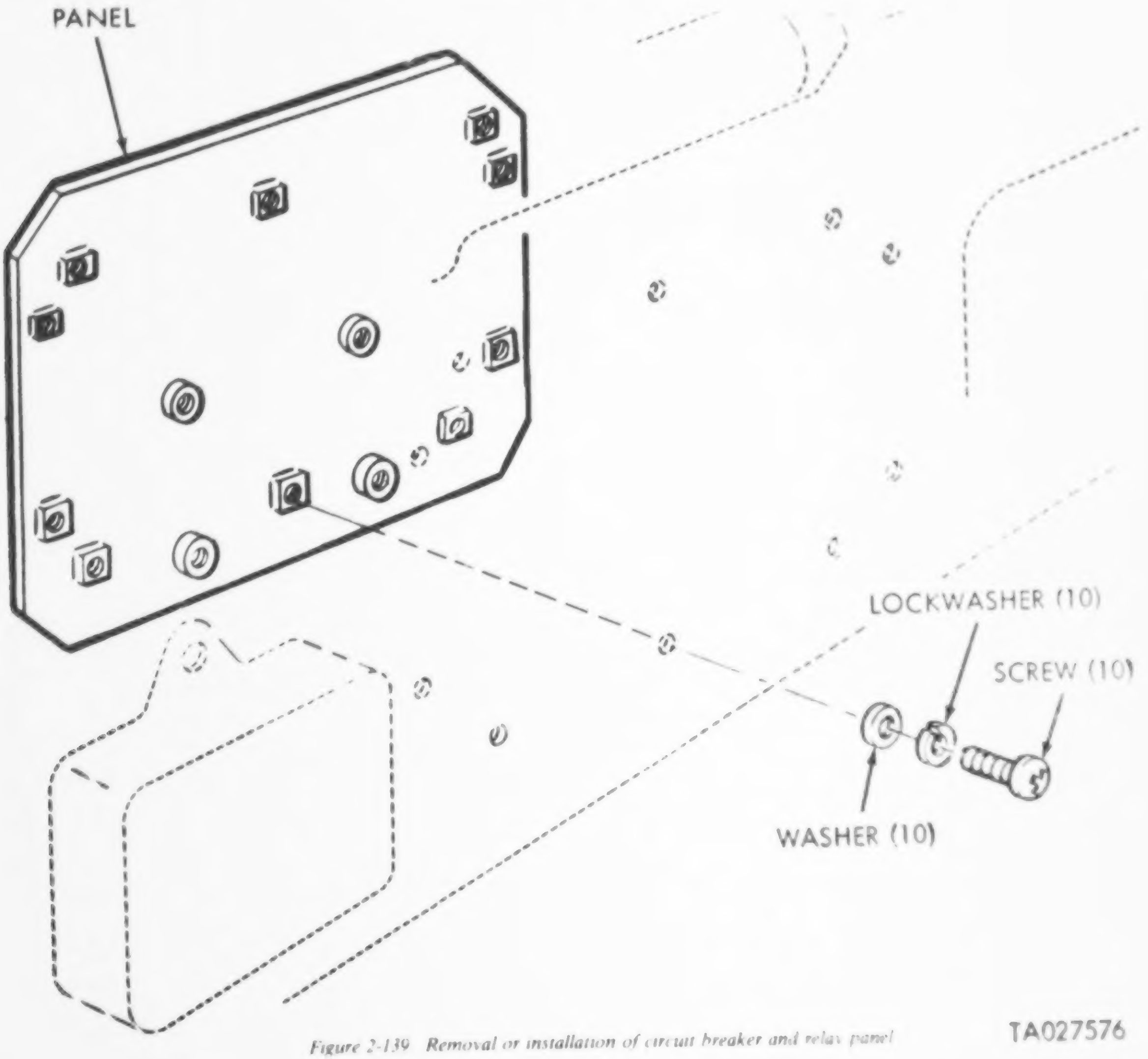


Figure 2-139. Removal or installation of circuit breaker and relay panel.

TA027576

2-79. Instrument Panel Wiring

Figs. 2-140 through 2-142

a. Refer to tabulated wiring information on figures 2-140 and 2-141 for fabrication of instrument panel cable assemblies. Replace or repair cable assemblies as required. Refer to figure 2-142 for cable terminal details.

b. Maintain marker bands with circuit numbers stamped on them on all cables.

c. Position rubber tubing over bare cable ends that are to be soldered. Solder bare cable ends as required to designated component terminals. After soldering is finished, heat shrink rubber tubing over soldered area.

CAUTION

Do not apply open flame directly to rubber tubing.

d. Prior to connecting unsoldered terminals or connectors, and after soldered terminals are attached, coat all exposed surfaces with adhesive (10946213).

e. Bundle wire routing with tape.

f. Replace defective diodes by soldering diode in place in old location.

COMPONENT NAME	FROM	TERMINAL	INSULATOR*	CKT NO	WIRE	CKT NO	INSULATOR*	TERMINAL*	TO	COMPONENT NAME
LEFT INST PANEL RECEPTACLE	J1-A	SOLDER		439A	M13486/1-5	439A		"B"	S2-2	ENGINE STOP SWITCH
	J1-C	SOLDER		76A	M13486/1-5	76A		"E"	S3-2	AUX FUEL PUMP SWITCH
	J1-D	SOLDER		76	M13486/1-5	76		"F"	S2-2	ENGINE STOP SWITCH
LEFT INST PANEL RECEPTACLE	J1-E	SOLDER		76B	M13486/1-5	76B		"E"	S3-3	AUX FUEL PUMP SWITCH
	J1-F	SOLDER		27 SPLICE	M13486/1-5	27		"B"	M1	BATT/GEN IND GAGE
					M13486/1-5	27		"B"	M2	FUEL IND GAGE
					M13486/1-5	27		"B"	M3	TRANS TEMP GAGE
					M13486/1-5	27		"B"	M4	ENG OIL PRESS GAGE
					M13486/1-5	27		"B"	M5	ENG TEMP GAGE
	J1-G	SOLDER		30	M13486/1-5	30		"R"	M2 (RIB)	FUEL IND GAGE
	J1-H	SOLDER		54	M13486/1-5	54		"E"	S2-1	ENGINE STOP SWITCH
	J1-J	SOLDER		324	M13486/1-3	324		"R"	M3 (RIB)	
	J1-K	SOLDER		655	M13486/1-3	655	"C"	SOLDER	DS3-2	TRANS PRESS WARN LT
	J1-L	SOLDER		509	M13486/1-3	509	"C"	SOLDER	DS4-2	ENG/TRANS WARN LT
	J1-M	SOLDER		519	M13486/1-3	519	"C"	SOLDER	DS5-2	HI BEAM IND LIGHT
	J1-N	SOLDER		33	M13486/1-3	33	"C" OVER "C" SHIM	"R"	M5 (RIB)	ENG TEMP GAGE
	J1-P	SOLDER		36	M13496/1-5	36		"R"	M4 (RIB)	ENG TEMP GAGE
LEFT INST PANEL RECEPTACLE	J2-E	SOLDER		71	M13486/1-5	71		"E"	S4-2	WINDSHIELD WIPER SWITCH
	J2-F	SOLDER		71A	M13486/1-5	71A		"E"	S4-3	
LEFT INST PANEL RECEPTACLE	J2-H	SOLDER		471B	M13486/1-5	471B		"E"	S6-3	WINCH PTO SWITCH
	J2-J	SOLDER		471	M13486/1-5	471		"E"	S6-2	
	J2-K	SOLDER		471A	M13486/1-3	471A		"E"	S6-1	
	J2-M	SOLDER		85	M13486/1-3	85	"C"	SOLDER	S7-1	LO AIR PRESS BUZZER SHUT OFF SWITCH
	J2-N	SOLDER		85	M13486/1-3	85	"C"	SOLDER	S7-2	
	J2-P	SOLDER		GRD	M13486/1-3	GRD		"G"	RECPT MNT	
	J2-L	SOLDER		471C	M13486/1-3	471C	"D"	SOLDER	DS6-2	WINCH PTO "GO" LIGHT
DIODE	CR1 BLACK	SOLDER					"D"			
	CR1 WHITE	SOLDER								
	RECPT MNT	"G"		GRD	M13486/1-3	GRD	"D"	SOLDER	DS6-1	
				GRD	M13486/1-3	GRD				
HI BEAM IND LT	DS5-1	SOLDER	"D"	GRD	M13486/1-3	GRD	"D"	SOLDER	DS4-3	ENG/TRANS WARN LT
TRANS PRESS WARN LT	DS3-3	SOLDER	"C"	GRD	M13486/1-3	GRD				
ENGINE STOP SW	S2-2	"E"			M13486/1-3		"D"	SOLDER	DS6-3	WINCH PTO "GO" LIGHT
	DS5-3	SOLDER	"D"		M13486/1-3					
HI BEAM IND LIGHT					M13486/1-3		"D"	SOLDER	DS4-1	
TRANS PRESS WARN LT	DS3-1	SOLDER	"C"		M13486/1-3					ENG/TRANS WARN LT

*NOTE. SEE FIGURE 2-142 FOR DETAILS CALLED OUT BY LETTERS A, B, C, D, E, F, G AND R.

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Figure 2-140. Wiring tabulation for left instrument panel.

COMPONENT NAME	FROM	TERMINAL*	INSULATOR*	CKT NO	WIRE	CKT NO	INSULATOR*	TERMINAL*	TO	COMPONENT NAME
RIGHT INST PANEL RECEPTACLE	J4-A	SOLDER		40A	M13486/1-5	40A	"C"	SOLDER	DS1	3 WAY GAGE (AIR PRES)
						40A		"A"		TACHOGRAPH
	J4-B	SOLDER		685	M13486/1-5	685		"B"		
	J4-C	SOLDER		85	M13486/1-5	85	"C"	SOLDER	DS2-2	TRACT AIR PRES WARN LT
	J4-E	SOLDER		650	M13486/1-5	650	"C"	SOLDER	DS5-2	AUX P/S PRES WARN LT
	J4-F	SOLDER		27	M13486/1-5	27		"A"		TACHOGRAPH
	J4-G	SOLDER		14-486	M13486/1-5	14-486		SOLDER	S4-2	ETHER START SWITCH
HEATER MTG. STUD		"G"		GRD	M13486/1-5	GRD		"E"		PANEL GRD
RIGHT INST PANEL RECEPTACLE	J4-H	SOLDER		538	M13486/1-5	538	"C"	SOLDER	DS3-2	TRAILER AIR PRES WARN LT
	J4-J	SOLDER		14	M13486/1-5	14	"C"	SOLDER	K1-B2	NEU. SHIFT RELAY
	J4-K	SOLDER		486	M13486/1-3	486		"E"	S4-1	ETHER START SWITCH
	J4-L	SOLDER		411	M13486/1-3	411		"E"	S5-5	BLOWER
	J4-M	SOLDER		411B	M13486/1-3	411B		"E"	S5-2	BLOWER
	J4-N	SOLDER		411A	M13486/1-3	411A		"F"	S5-6	BLOWER
BLOWER	S5-3	"E"			M13486/1-3					
RT INST PNL RECPT	J4-P	SOLDER		GRD	M13486/1-5	GRD		"G"	RECP MTG SC	
RIGHT INST PANEL RECEPTACLE	J5-A	SOLDER		459A	M13486/1-3	459A		"B"	S3-RUN	STARTER SWITCH
	J5-B	SOLDER		459	M13486/1-5	459		"R"	S3-BAIT	STARTER SWITCH
	J5-C	SOLDER		402	M13486/1-5	402		"A"	HTR HARN INTR	
	J5-D	SOLDER		37	M13486/1-5	37		"E"	S2-2	TRAILER AUX PWR SW
	J5-E	SOLDER		37B	M13486/1-5	37B		"E"	S2-3	
	J5-F	SOLDER		37A	M13486/1-5	37A		"B"		UTILITY OUTLET
	J5-G	SOLDER		325A	M13486/1-5	325A		"E"	S1-3	
	J5-H	SOLDER		325	M13486/1-5	325A		"F"	S1-5	WARNING BEACON SW
WARNING BEACON SWITCH	S1-2	"E"			M13486/1-3					
	S1-6	"E"			M13486/1-5			"E"	S2-3	TRAILER AUX PWR SW
	S1-3	"E"			M13486/1-3		"C"	SOLDER	DS6-2	WARNING BEACN "GO" LT
							"D"	SOLDER	DS5-1	AUX P/S PRES WARN LT
WARN BCN "GO" LT	DS6-3	SOLDER	"D"		M13486/1-3					
					M13486/1-3			"F"	S5-5	BLOWER
TRL AIR PRES WARN LT	DS3-1	SOLDER	"D"		M13486/1-3					
					M13486/1-3		"C"	SOLDER	DS2-3	TRACT AIR PRES WARN LT
							"D"	SOLDER	DS5-3	AUX P/S PRES WARN LT
WARN BCN "GO" LT	DS6-1	SOLDER	"D"		M13486/1-3					
					M13486/1-3			"F"	PNL GRND	
TRCT AIR PRES WARN LT	DS2-1	SOLDER	"D"		M13486/1-3					
					M13486/1-3		"C"	SOLDER	DS3-3	TRAILER AIR PRES WARN LT

*NOTE. SEE FIGURE 2-142 FOR DETAILS CALLED OUT BY LETTERS A, B, C, D, E, F, G AND R.

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Figure 2-141. Wiring tabulation for right instrument panel.

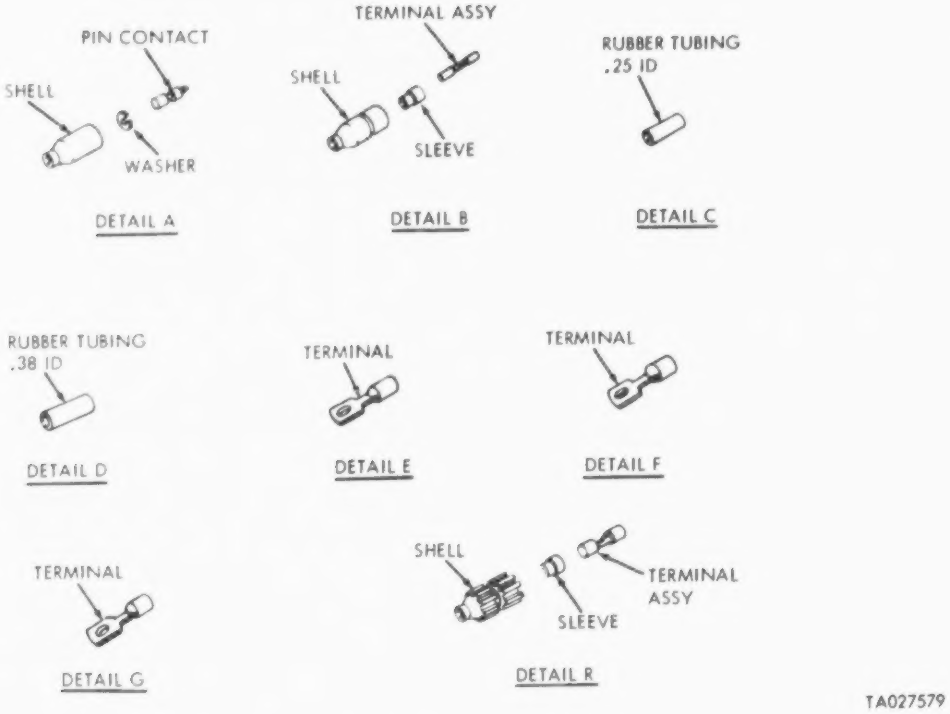
PIN CONTACT
SHELL
WASHER
DETAIL A
TERMINAL ASSY
SHELL
SLEEVE
DETAIL B
RUBBER TUBING
.25 ID
DETAIL C
RUBBER TUBING
.38 ID
DETAIL D
TERMINAL
DETAIL E
TERMINAL
DETAIL F
TERMINAL
DETAIL G
SHELL
TERMINAL ASSY
SLEEVE
DETAIL R
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Figure 2-142. Instrument panel cable assembly components.

Section XV. MISCELLANEOUS ELECTRICAL AND MECHANICAL COMPONENTS

2-80. General

This section contains replacement procedures for directional signal control, windshield washer pump, horn, low air pressure warning indicator (buzzer), transmission retard and brake switch, foot dimmer switch, intervehicular and auxiliary electrical receptacles, windshield wipers, windshield washer reservoir tubing nozzle and access cover, and winch PTO switch and light. Access to some of these components and mounting hardware is located behind front access door.

2-81. Directional Signal Control

a. *Removal (fig. 2-143).*

(1) Disconnect electrical cable connector underneath directional signal control (1).

(2) Unscrew and disconnect clamp securing signal control to steering column and remove directional signal control.

b. *Replacement of Lamp.* Unscrew lens. Push and turn lamp to release lamp. Install new lamp and install lens.

c. *Installation.* Position control assembly on steering column adjacent to steering wheel base by tightening and securing screw clamp connecting signal control to steering column. Connect electrical cable connector underneath directional signal control (1).

2-82. Windshield Washer Pump

NOTE

Items called out by number in this sequence refer to figure 2-143.

a. *Removal.*

(1) Disconnect two hose connections to windshield washer pump (5).

(2) Remove two screws (6), lockwashers (3), and nuts (2) securing pump to mounting bracket (4) and remove pump.

NOTE

Refer to paragraph 2-89 for washer reservoir, tubes, and nozzles.

b. *Installation.* Position pump on mounting bracket and secure by installing two screws (6), lockwashers (3), and nuts (2). Connect two hose connections to windshield washer pump (5).

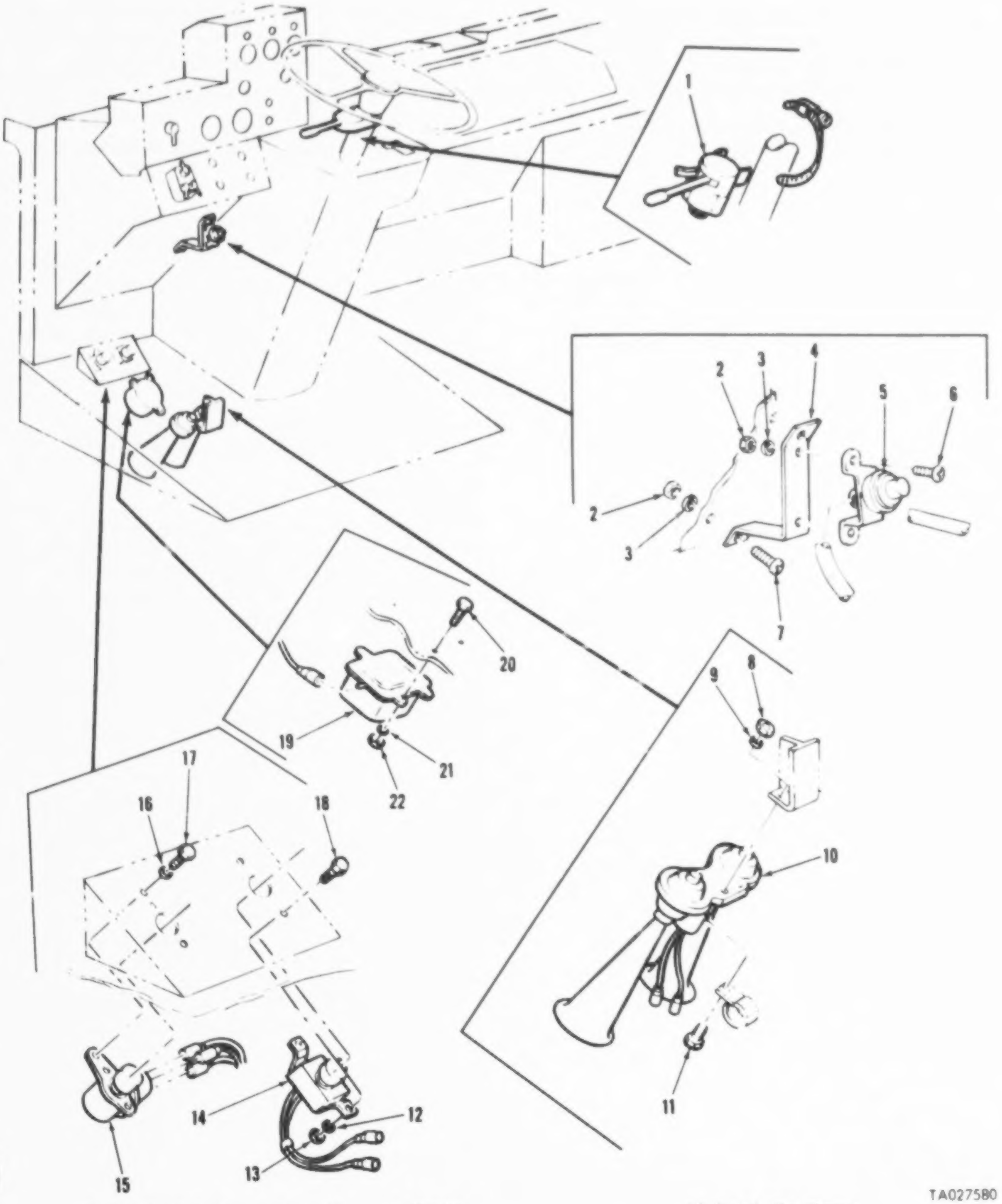
2-83. Air Horn

Fig. 2-143

a. *Removal.*

(1) Disconnect two electrical connectors (circuit 25) from horn (10)

(2) Remove two nuts (8), lockwashers (9), and screws (11) securing harness cable clamp and horn to mounting bracket and remove horn.


1
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TA027580

1 Directional signal control assembly
2 Nut (4)
3 Lockwasher (4)
4 Bracket
5 Pump
6 Screw (2)
Screw (2)
8 Nut (2)
9 Lockwasher (2)
10 Horn
11 Screw (2)
12 Lockwasher (2)
13 Nut (2)
14 Switch, transmission retarder
15 Switch, foot dimmer
16 Lockwasher
17 Screw (3)
18 Screw (2)
19 Buzzer, low air pressure warning
20 Screw (3)
21 Lockwasher (3)
22 Nut (3)

Figure 2-143. Miscellaneous electrical components.

b. Installation. Position harness cable clamp and horn on mounting bracket and secure by installing two nuts (8), lockwashers (9), and screws (11). Connect two electrical connectors (circuit 25) on horn (10).

2-84. Low Air Pressure Warning Indicator (Buzzer)

NOTE

Items called out by number in this sequence refer to figure 2-143.

a. Removal.

(1) Disconnect electrical connector (circuit 85-685A) from low air pressure warning indicator (buzzer) (19).

(2) Remove three screws (20), lockwashers (21), and nuts (22) securing buzzer to cab and remove buzzer.

b. Installation. Position buzzer on cab and secure by installing three screws (20), lockwashers (21), and nuts (22). Connect electrical connector on low air pressure warning indicator (buzzer) (19).

2-85. Transmission Retarder Switch

Fig. 2-143

a. Removal.

(1) Disconnect two electrical connectors (circuits 653, 53) from transmission retard and brake switch (14).

(2) Remove two screws (18), lockwashers (12), and nuts (13) securing switch to cab floor. Remove switch.

b. Repair. Repair switch cables or terminals as required. Maintain marker bands on cables.

c. Installation. Position transmission retarder on cab floor and install two screws (18), lockwasher (12), and nuts (13). Connect two electrical connectors (circuits 653, 53) on transmission retard and brake switch.

2-86. Foot Dimmer Switch

NOTE

Items called out by number in this sequence refer to figure 2-143.

a. Removal.

(1) Disconnect three electrical connectors (circuits 16, 17, 18) from foot dimmer switch (15).

(2) Remove three screws (17) and lockwashers (16) securing switch to cab floor and remove switch.

b. Installation. Position foot dimmer switch on cab floor and install three screws (17) and lockwashers (16). Connect three electrical connectors (circuits 16, 17, 18) on foot dimmer switch (15).

2-87. Intervehicular and Auxiliary Electrical Receptacles

Fig. 2-144

NOTE

There are three auxiliary electrical receptacles mounted on the rear of the vehicle. The removal procedures are the same for all receptacles.

a. Removal. Remove four screws, lockwashers, and nuts securing cover assembly, receptacle, and gasket to vehicle. Remove cover assembly, gasket, and receptacle.

b. Installation. Position cover assembly, receptacle, and gasket on vehicle and secure by installing four screws, lockwashers, and nuts.

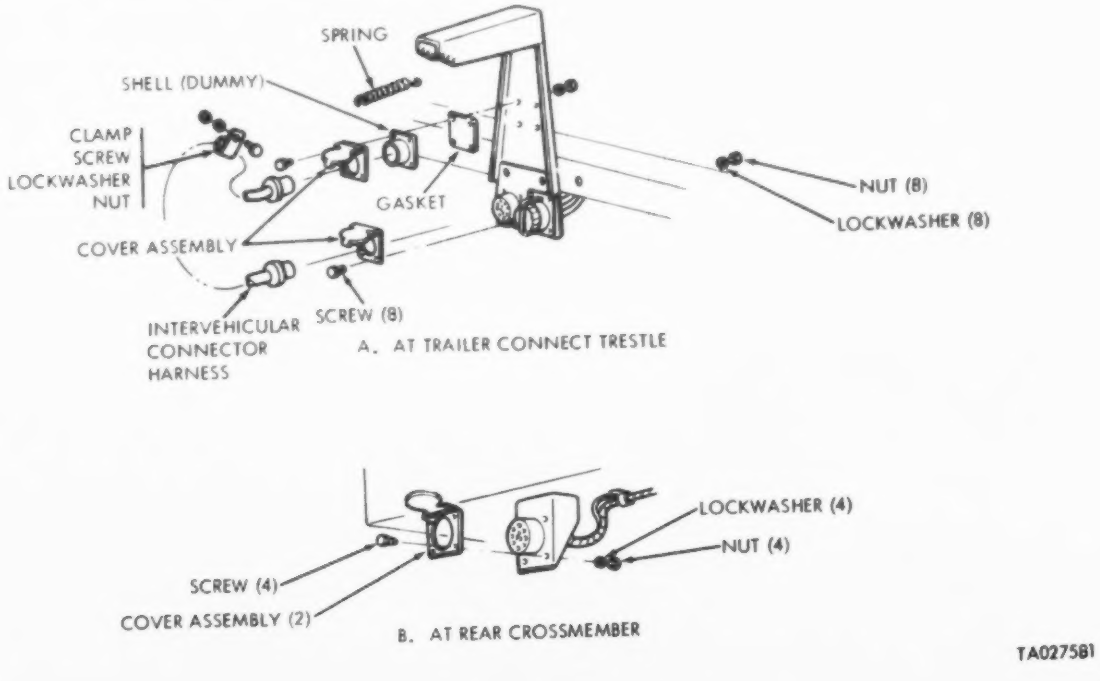


Figure 2-144. Intervehicular and auxiliary electrical receptacle.

2-88. Windshield Wipers

Fig. 2-145

a. Windshield Wiper Arm and Blade.

(1) *Removal.* Disconnect wiper blade (3) from arm (2). Remove nut (1) and arm (3) from pivot (5) shaft.

(2) *Installation.* Position arm (2) on pivot (5) shaft. Secure with nut (1). Connect wiper blade (3) on arm (2).

(3) *Adjustment.* Remove blade and arm assembly from drive stud. Position blade and arm assembly on drive stud until wiper travel is within windshield glass area and is synchronized to avoid collision with companion wiper.

b. Windshield Wiper Pivot.

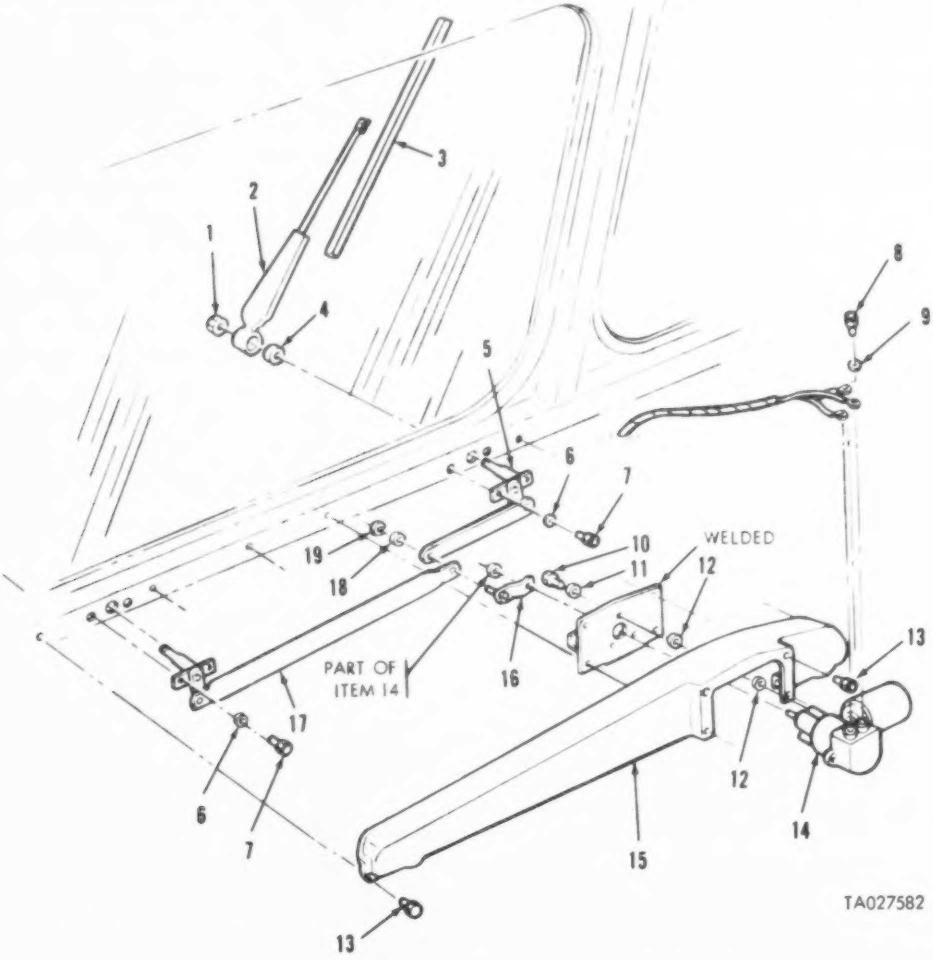
(1) *Removal.* Remove two screws (7), and lockwashers (6) securing pivot assembly (5) and related parts to cab frame. Remove pivot assembly (5) and related parts as required.

(2) *Installation.* Position pivot assembly (5) on frame and secure by installing two screws (7) and lockwashers (8).

c. Windshield Wiper Motor.

(1) *Removal.* Remove ten screws (13) mounting either right or left cover (15) to cab. Remove cover. Remove hardware securing wiring harness terminals to motor (14). Remove motor component securing motor to arm (16). Remove three screws (10), lockwashers (11), and flat washers (12) securing motor to bracket.

(2) *Installation.* Place wiper motor (14) on bracket and secure motor to bracket with three screws (10), lockwashers (11), and six washers (12). Position arm (16) on motor shaft and secure arm to shaft with motor com-



1 Nut (4)
2 Arm (4)
3 Blade (4)
4 Bushing (4)
5 Pivot assembly (4)
6 Lockwasher (8)
7 Screw (8)
8 Screw (2)
9 Lockwasher (2)
10 Screw socket head (6)
11 Lockwasher (6)
12 Flat washer (12)
13 Screw, tapping (20)
14 Motor (2)
15 Cover (2)
16 Arm (2)
17 Pivot and arm (2)
18 Spacer (2)
19 Ring (2)

Figure 2-145. Removal or installation of windshield wiper.

ponent fastener. Position wiring harness terminals on motor (14) and secure wiring harness to motor. Position mounting cover (12) to cab and secure mounting cover by installing ten tapping screws (13).

d. Windshield Wiper Motor Linkage.

(1) *Removal.* Remove cotter pin (15) securing shim (16), link assembly (14), spacer (12), and washer (13) to arm assembly (11). Remove arm assembly. Remove snapring (26) and spacer (27) securing spacer (28), link assembly (14), link assembly (30), and arm (29). Remove link assembly (14) and arm (29). Remove cotter pin (32) securing shim (33), spacer (34), link assembly (30), and washer (35) to arm assembly (36). Remove arm assembly and link assembly.

(2) *Installation.* Assemble washer (35), link assembly (30), spacer (34), and shim (33) on arm assembly (36) and install cotter pin (32). Position spacer (28), link assembly (14), link assembly (30), and spacer (27) on arm (29) and secure by installing snapring (26). Place washer (13), spacer (12), link assembly (14), and shim (16) on arm assembly (11) and install cotter pin (15).

2-89. Windshield Washer Reservoir, Tubing, Nozzles and Access Cover

Fig. 2-146.

NOTE

Refer to paragraph 2-82 for washer pump.

a. Windshield Washer Reservoir and Access Cover.

(1) *Removal.*

(a) Unlock cover assembly from receptacle nut on dash panel.

(b) Remove two screws and lockwashers securing cover assembly and plate to dash panel. Remove cover assembly and plate.

(c) Unscrew cover from reservoir. Remove strainer and cover from tubing.

(d) Remove two screws, lockwashers, and washers securing reservoir to bracket. Remove reservoir.

(e) Remove receptacle nut from dash panel and plate.

(f) Remove two screws and lockwashers securing plate to dash panel.

(g) Remove two screws, lockwashers, and nuts securing bracket to dash panel. Remove bracket.

(2) *Installation.*

(a) Install two screws, lockwashers, and nuts and secure bracket to dash panel.

(b) Install two screws and lockwashers and secure plate to dash panel.

(c) Install receptacle nut to dash panel and plate.

(d) Install two screws, lockwashers, and washers and secure reservoir to bracket.

(e) Assemble strainer and cover to tubing and install cover to reservoir.

(f) Install two screws and lockwashers and secure cover assembly and plate to dash panel.

(g) Lock cover assembly to receptacle nut on dash panel.

b. Windshield Washer Tubing.

(1) *Removal*

(a) Remove five screws and lockwashers securing tube clamps. Remove clamps.

(b) Disconnect two tubes from left and right side spray nozzles.

(c) Remove tubing from right side spray nozzle to tee.

(d) Disconect tubing from left side spray nozzle and pump tubing from tee. Remove spray nozzle tubing and tee.

(e) Disconnect spray nozzle tubing from pump. Remove tubing through grommet.

(f) Disconnect reservoir tubing from strainer and cover.

(g) Disconnect reservoir tubing from pump. Remove tubing through grommet.

(2) *Installation.*

(a) Connect reservoir tubing to pump.

(b) Connect reservoir tubing to strainer and cover.

(c) Connect spray nozzle tubing to pump.

(d) Connect tubing to left side spray nozzle and pump tubing to tee.

(e) Install tubing to right side spray nozzle to tee.

(f) Connect two tubes to left and right side spray nozzle.

(g) Install five screws and lockwashers to secure tube clamps.

(3) *Cleaning.* Use compressed air to clean tubing of foreign matter or obstruction.

c. Windshield Washer Spray Nozzle Assemblies.

(1) Removal.

(a) Remove four screws and lockwashers securing spray nozzle assembly to cab.

(b) Remove spray nozzle assembly.

(2) *Installation.* Install spray nozzle assembly and install four screws and lockwashers securing spray nozzle assembly to cab.

(3) *Cleaning.* Use compressed air to clean tubing of foreign matter or obstruction.

(4) *Adjustment.* Loosen locknut and turn nozzle for most effective spray pattern.

2-90. Winch Station PTO Switch and Light

a. Winch PTO Switch.

(1) *Removal.* Disconnect three electrical connectors from PTO switch. Note connector locations for future installation. Remove two screws and lockwashers securing switch. Remove switch.

(2) *Installation.* Position winch PTO switch and install two screws and lockwasher to secure switch. Connect three electrical connectors to PTO switch.

b. Winch Station PTO Light Assembly.

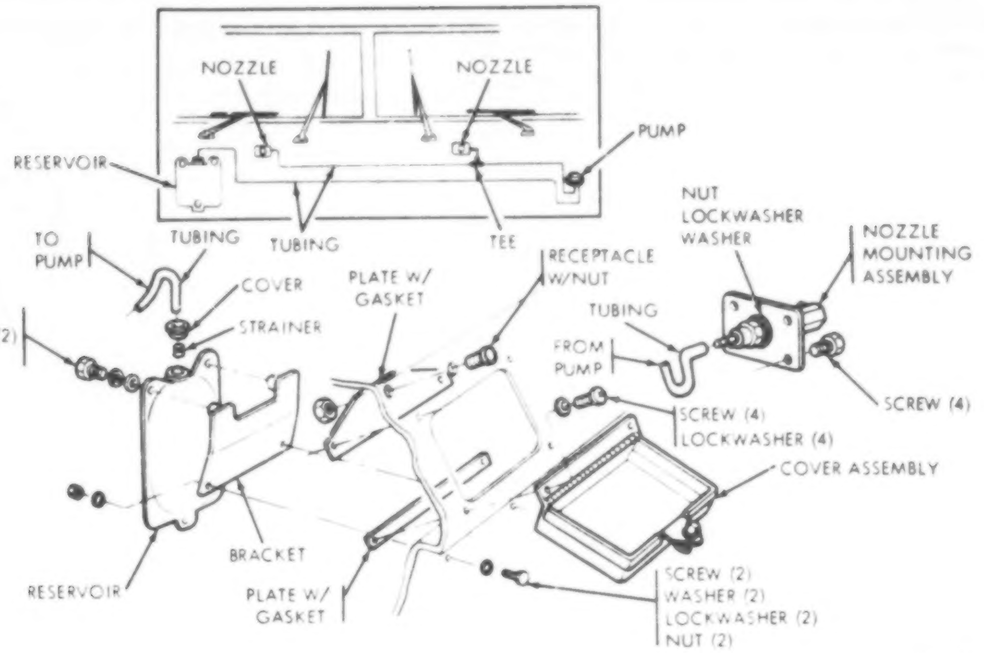

NOZZLE
NOZZLE
PUMP
RESERVOIR
TUBING
TUBING
TEE
TO PUMP
COVER
STRAINER
SCREW (2)
LOCKWASHER (2)
WASHER (2)
PLATE W/ GASKET
RECEPTACLE W/NUT
NUT
LOCKWASHER
WASHER
NOZZLE MOUNTING ASSEMBLY
TUBING
FROM PUMP
SCREW (4)
SCREW (4)
LOCKWASHER (4)
COVER ASSEMBLY
BRACKET
RESERVOIR
PLATE W/ GASKET
SCREW (2)
WASHER (2)
LOCKWASHER (2)
NUT (2)

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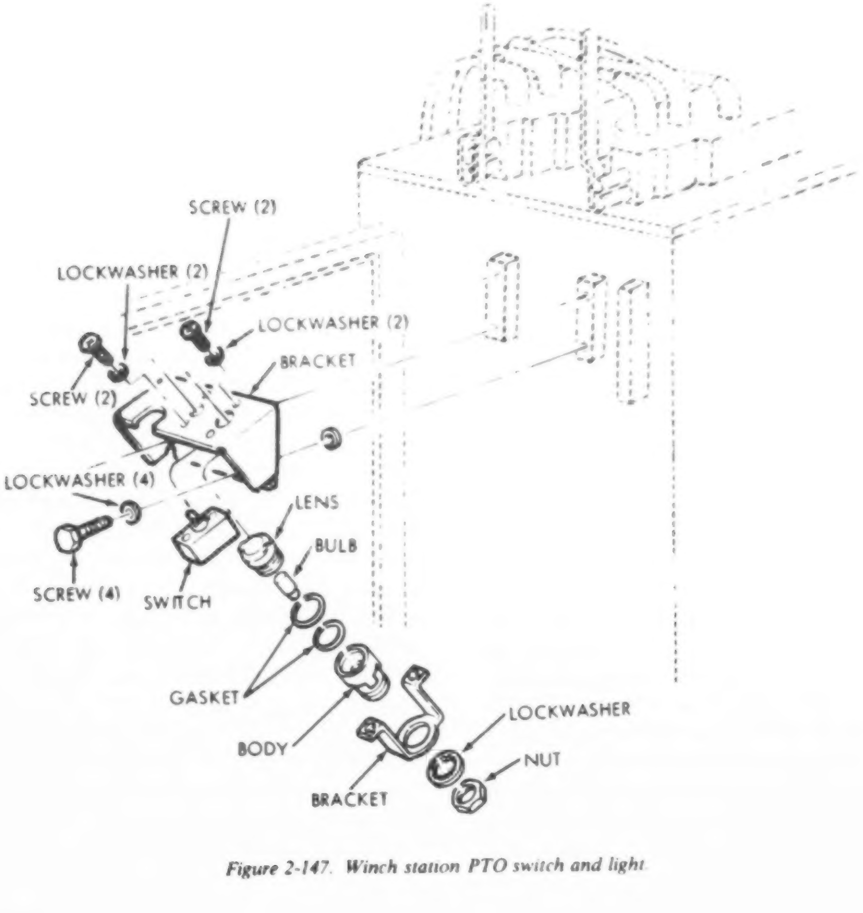
Figure 2-146. Windshield washer reservoir, tubing, nozzles, and access cover.


SCREW (2)
LOCKWASHER (2)
LOCKWASHER (2)
BRACKET
SCREW (2)
LOCKWASHER (4)
LENS
BULB
SCREW (4)
SWITCH
GASKET
BODY
LOCKWASHER
NUT
BRACKET

TA027584

Figure 2-147. Winch station PTO switch and light.

(1) *Removal.* Disconnect electrical connector from PTO light assembly. Unscrew lens and gasket from light assembly. Push in on lamp and turn to remove. Remove two screws and lockwashers securing light bracket to winch station. Remove light assembly.

(2) *Repair.* Unscrew nut and washer securing bracket to light body. Check parts for wear, deformation, and corrosion. Replace parts where required.

(3) *Installation.* Position light assembly on winch station and secure light assembly by installing two screws and lockwashers. Install lamp in light assembly by pushing in and turning. Install lens and gasket on light assembly and tighten down. Connect electrical connector to PTO light assembly.

c. Winch Station PTO Controls Bracket.

(1) *Removal.* Remove engine throttle control push-pull assembly (para 2-45). Remove four screws and lockwashers securing bracket to reservoir. Remove bracket.

(2) *Installation.* Install bracket to reservoir with four screws and lockwashers. Install engine throttle control push-pull assembly (para 2-45).

2-91. Auxiliary Power Steering Hydraulic Pressure Switch

Fig. 2-148

a. Replacement. Refer to paragraph 2-142*c*.

b. Repair. Replace terminal parts or marker bands as required.

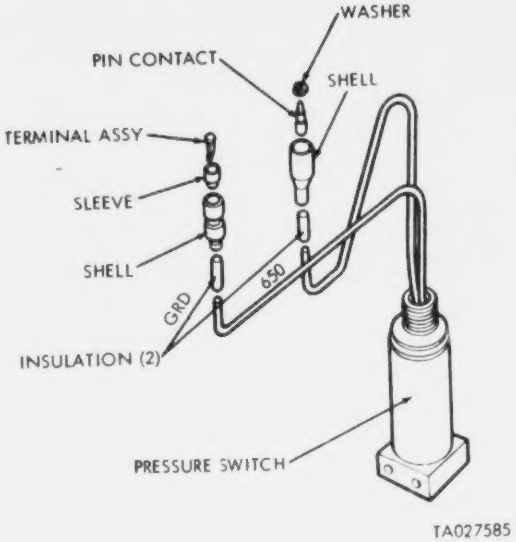


Figure 2-148. Auxiliary power steering hydraulic pressure switch.

Section XVI. TRANSMISSION, TRANSFER, AND POWER TAKE OFF ASSEMBLIES

2-92. Description and Data

a. Description. The transmission assembly is mounted to the engine flywheel housing on one end and to the transfer assembly on the other. The engine and transmission are supported by the frame on mounting brackets, while the transfer assembly is supported by the transmission. Rubber insulators are installed between the mounting brackets and frame brackets to suppress vibration. The hydraulic torque converter is connected to the engine flywheel and transfers power to the transmission with either converter drive (torque multiplication) or direct drive. A hydraulic retarder is incorporated in the torque converter to absorb power during the braking (retarding) mode. The transfer assembly is of the drop-box type and drives the propeller shafts for the front and rear tandems in either the differential or locked differential mode. Intertandem differential lockout is air actuated through the use of a control valve in the cab. The transfer assembly is lubricated by transmission oil which is circulated by an engine mounted, direct-driven lube and scavenger pump and power takeoff assembly. Two power takeoffs (PTO) are mounted on the transmission right side. The lower PTO drives the winch hydraulic pump. The clutch plates for this PTO are engaged by hydraulic pressure tapped from the transmission. Application of hydraulic pressure is controlled by a solenoid activated by a switch at the winching station. The upper PTO drives the oil scavenger pump. Also mounted on the transmission assembly are the torque converter pump housing, the retarder valve assembly, the lockup clutch assembly, the hydraulic range valve assembly, and the oil filter assembly. The hydraulic range valve assembly controls the transmission's five forward and one reverse speeds, and is, itself, electrically controlled by the cab transmission range selector. The transmission oil filter assembly is mounted high on the rear of the transfer case, keeps transmission oil free of impurities, and must be cleaned or serviced periodically.

b. Data. Refer to TM 9-2320-258-10.

2-93. List of Operations Performed with Transmission in the Vehicle

All organizational maintenance operations on the transmission and transmission accessories must be performed with the transmission installed in the vehicle. These maintenance operations, with reference to the specific paragraph for detailed instructions, are listed below.

a. Oil drains and filler tubes (para 2-95).
b. Transmission oil filter (para 2-94).
c. Transmission strainer screen (para 2-95).
d. Converter scavenge pump oil strainer element (para 2-96).
e. Transfer case strainer (para 2-95).
f. Transmission range selector (para 2-97).
g. Transfer assembly lube and scavenge pump (para 2-99).
h. Transfer assembly lube and scavenge pump PTO (para 2-100).
i. Winch power takeoff (para 2-101).
j. Winch PTO solenoid and oil lines (para 2-102).
k. Transmission and transfer breather vents (para 2-103).
l. Speedometer drive unit (para 2-98).
m. Sending units (para 2-61).
n. Intertandem differential air pressure hose (para 2-123*e* and *f*).

2-94. Transmission Oil Filter

Fig. 2-149

a. General. The transmission oil filter is a full-flow type. Impurities are filtered out as oil is forced through the element to a central passage surrounding the center stud. The filter operates at flow rate of 30 gpm and has an operating range of from -65° F to 275° F.

b. Replacing Element.

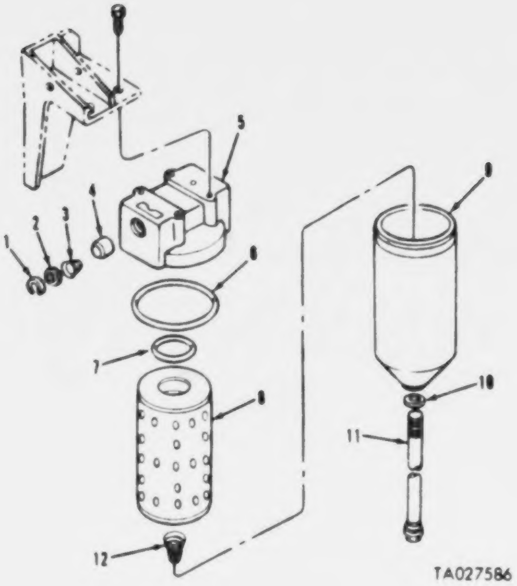
(1) *Removal.* Remove bolt (11) and washer (10). Remove body (9) with components inside. Remove preformed packing (6), gasket (7), element (8), and spring (12) from body.

(2) *Inspections and cleaning.* Discard element (8). Inspect parts for damage and replace if necessary. Clean parts with dry cleaning solvent or mineral spirits paint thinner and dry with compressed air. Run finger inside of base (5) to check for sludge, and clean with rag if necessary. If sludge is present in the area of the body outlet port, remove and clean retaining ring (1), washer (2), spring (3), and poppet (4).

c. Installation. Install spring (12), element (8), gasket (7), and preformed packing (6) in body. Position components inside body (9) and secure with bolt (11) and washer (10).

2-95. Transmission and Transfer Drains, Strainer Screens, and Oil Filter Tube Assembly

Fig. 2-150



1 Retaining ring
2 Washer
3 Spring
4 Poppet
5 Base
6 Preformed packing
7 Gasket
8 Element
9 Body
10 Washer
11 Bolt
12 Spring

Figure 2-149. Transmission oil filter — exploded view.

a. Transmission Drain Plug. The transmission drain plug (17) is located on the strainer cover plate (19). When draining (approximately 72 qts.) allow sufficient time for oil to drain from both the transmission and torque converter.

b. Transfer Case Drain Plug. The transfer drain (9) is located at the lower left front corner of the transfer housing. The vehicle should be positioned on level ground when draining.

c. Oil Filler Tube and Cap.

(1) *General.* The oil filler tube (8) is located at the left rear of the transmission and contains the oil level dipstick gage (7).

(2) *Repairing.* Replace cap (1), spring (26), cap mounting bolts (2), filler tube identification plate (3), or filler tube as required.

d. Oil Level Gage Replacement. Replace oil level gage (7) if broken or if indication marks are worn off.

e. Transmission Oil Strainer Screen. After transmission oil has been drained, remove six screws (20) securing strainer cover plate (19) and remove cover plate and gasket (21). Remove two screws (22) securing strainer screen shroud (23) and remove shroud, gasket (24), strainer screen (25), and gasket (24). Clean strainer screen in clean diesel fuel oil. Replace strainer screen or gaskets if damaged. For installation, assemble gasket (24), strainer screen (25), gasket (24), and strainer screen shroud (23) and install two screws. Position gasket (21) and strainer cover plate (19) and install six screws.

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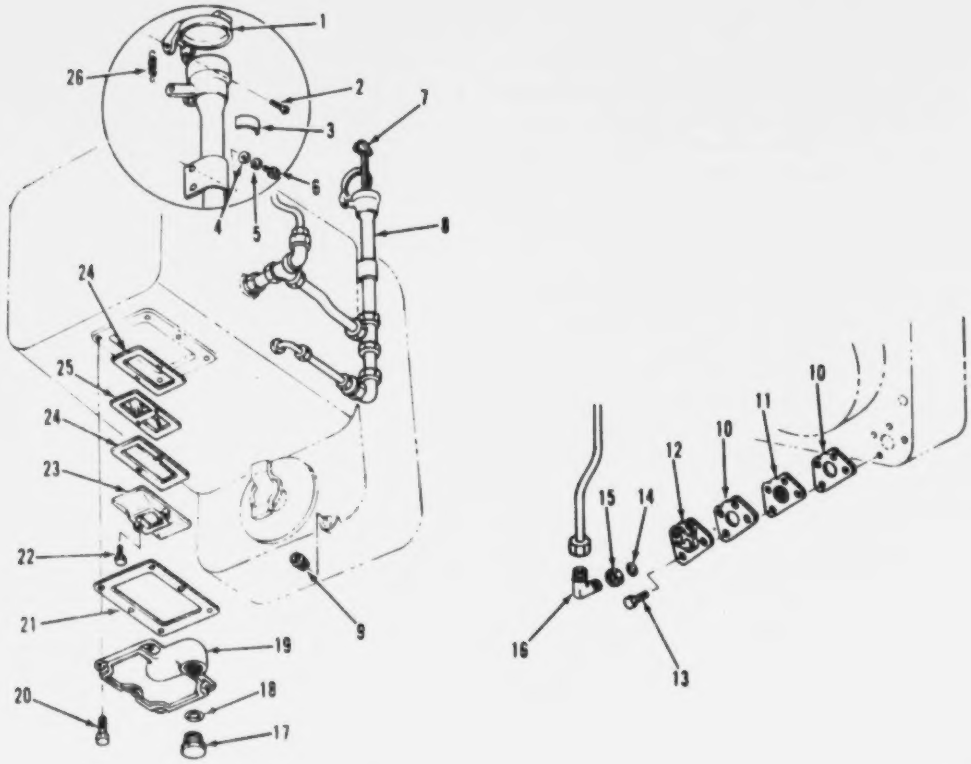


TA027587

1 Cap assembly
2 Bolt (2)
3 Identification plate
4 Washer (2)
5 Lockwasher (2)
6 Screw (2)
7 Oil level gage (dipstick)
8 Filler tube
9 Plug, transfer drain
10 Gasket (2)
11 Oil strainer, transfer
12 Strainer cover
13 Screw (4)
14 Packing
15 Nut
16 Elbow
17 Plug, transmission drain
18 Preformed packing
19 Strainer cover plate
20 Screw (6)
21 Gasket
22 Screw (2)
23 Strainer screen shroud
24 Gasket (2)
25 Strainer screen, transmission
26 Spring

Figure 2-150. Transmission and transfer drains, oil strainers, and oil filler tube assembly.

f. Transfer Assembly Oil Strainer. After oil has been drained from transfer assembly, disconnect tube assembly at rear lower right of transfer housing. Remove four screws (13) securing strainer cover (12) to transfer assembly. Remove cover, two gaskets (10), and oil strainer (11). Clean oil strainer thoroughly in clean diesel fuel oil. For installation, position strainer, two gaskets and cover on transfer assembly and secure with four screws. Connect tube assembly at rear lower right of transfer housing.

2-96. Torque Converter Scavenge Pump Oil Strainer

Fig. 2-151

a. Cleaning Strainer Element. Remove strainer hex-head plug and gasket and remove strainer element. Clean thoroughly in clean diesel fuel oil. Blow dry with compressed air. For installation, position strainer element and gasket, and tighten hex-head plug.

b. Replacement of Strainer. Disconnect hose assembly from elbow at strainer. Loosen jamnut securing strainer assembly in scavenge pump and unscrew strainer assembly from pump. Remove washer and packing. Remove elbow and preformed packing from strainer. For installation, place preformed packing and elbow in strainer. Install packing and washer. Install oil strainer assembly in scavenge pump and tighten jamnut. Connect hose assembly on elbow at strainer.

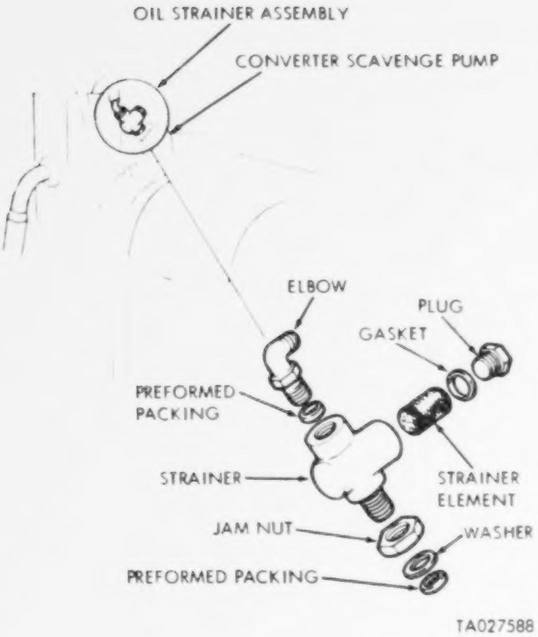

OIL STRAINER ASSEMBLY
CONVERTER SCAVENGE PUMP
ELBOW
PLUG
GASKET
PREFORMED PACKING
STRAINER
STRAINER ELEMENT
JAM NUT
WASHER
PREFORMED PACKING
TA027588

Figure 2-151. Converter scavenge pump oil strainer

2-97. Transmission Range Selector

Figs. 2-152 and 2-153

a. Removal. Remove clamp (under cab) securing drain hose (fig. 2-122) and push hose end up into battery box. Disconnect adjacent hydraulic hose at connector beneath range selector. Plug open line. Lift up seat covering battery box. Unscrew electrical connector at bottom of range selector. Disconnect range selector light cable. Remove two screws and lockwashers securing right side of range selector and bracket assembly to battery box. Remove two screws, lockwashers, and washers securing left side of range selector and bracket assembly to battery box. Lift range selector and bracket assembly from battery box with drain hose and hydraulic line attached. Disconnect hydraulic line and drain hose. Remove four screws (fig. 2-153) and lockwashers securing range selector to bracket.

b. Repair. Repair of the range selector consists of replacing the lamp, light assembly, or light cable (fig. 2-153). When a new range selector is installed, assemble drain hose adapter plate to range selector using sealing compound and four screws. Install elbow in plate. Install adapter in hydraulic down-shift inhibitor port. Replace seals in mounting bracket, as required, using suitable sealing compound.

c. Installation. Assemble range selector in bracket assembly using two long screws and lockwashers and two short screws and lockwashers. Connect drain hose to elbow. Lift hydraulic line from battery box and connect to adapter in range selector hydraulic port. Position range selector and bracket assembly on battery box. Reach under range selector and connect electrical cable and harness. Push drain hose through hole in cab floor. Install two screws, washers, and lockwashers on left side, plus two screws and lockwashers, on right side of range selector and bracket assembly. Attach clamp to drain hose under cab and secure clamp with screw holding cable clamp. Connect hydraulic line under cab at adapter.

2-98. Speedometer and Tachometer Drive Adapters and Shaft Assemblies

Figs. 2-154 and 2-155

a. Removal. Refer to figure 2-154 and remove speedometer and tachometer drive adapters and shaft assemblies, as required. Unscrew shaft assemblies before attempting to remove drive adapters. Do not lose drive adapter keys when removing adapters.

NOTE

The speedometer drive adapter key at the transfer assembly is not the key furnished with the adapter.

Adapters should be cleaned thoroughly in dry-cleaning solvent or mineral spirits paint thinner before reinstalling. Remove speedometer or tachometer shaft assembly at both ends to replace shaft flexible core. Pull square end of flexible core out from the shaft.

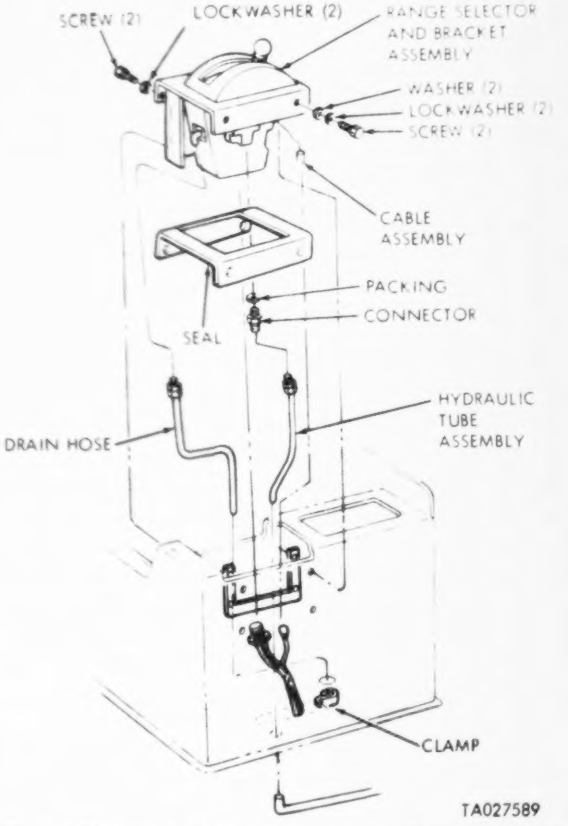

SCREW (2)
LOCKWASHER (2)
RANGE SELECTOR AND BRACKET ASSEMBLY
WASHER (2)
LOCKWASHER (2)
SCREW (2)
CABLE ASSEMBLY
PACKING
CONNECTOR
SEAL
HYDRAULIC TUBE ASSEMBLY
DRAIN HOSE
CLAMP
TA027589

Figure 2-152. Removal or installation of transmission range selector

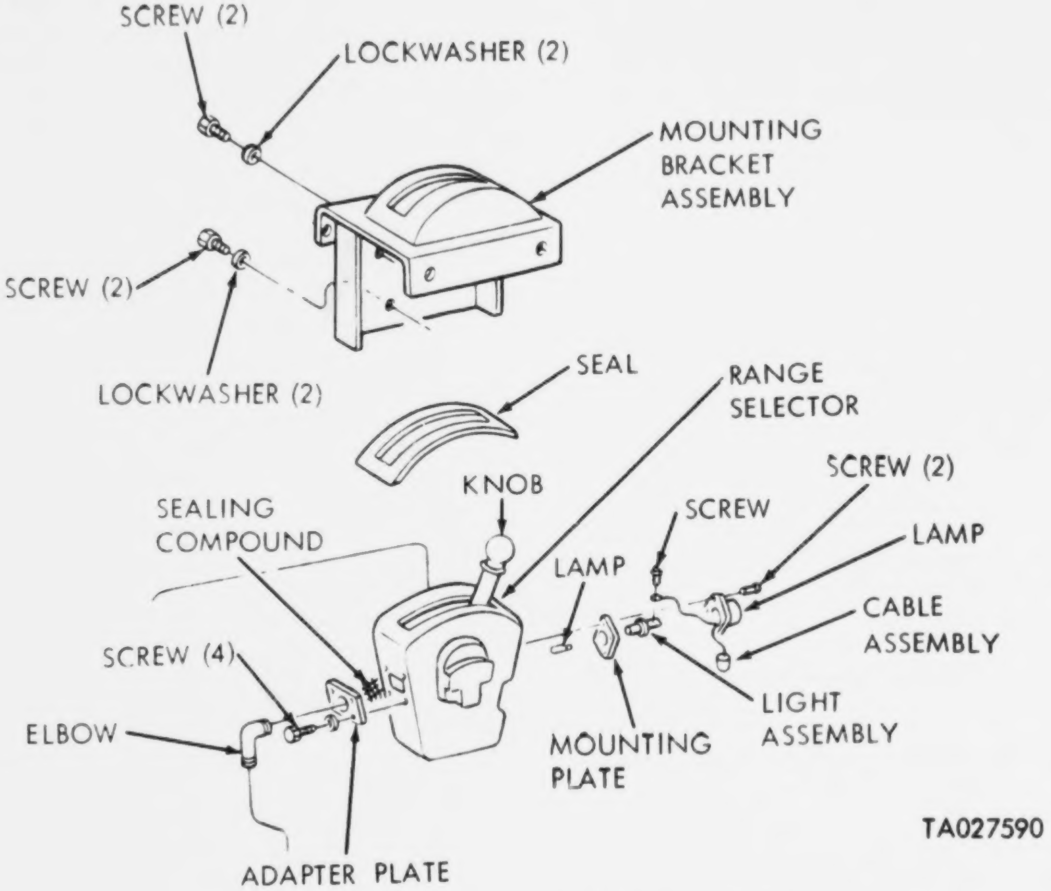


Figure 2-153. Transmission range selector and associated parts.

b. Installation. Wipe drive portions of adapters and shafts with grease. Wipe flexible core with grease during installation. Install flexible core into shaft. Install speedometer or tachometer shaft assembly at both ends.

2-99. Transfer Assembly Lube and Scavenge Pumps and Hose Assemblies Figs. 2-156 and 2-157

a. General. The transfer assembly lube and scavenge pump is a double action pump assembly. The pump assembly is mounted on the right rear of the transmission, directly coupled to a power takeoff (PTO) assembly. The PTO is directly gear driven by the transmission, and in turn, drives the double action pump. One half of the pump is the scavenge section while the other half is the lube pump. The lube and scavenge pumps generate 250 ± 50 psig pressure.

b. Removal of Pump. (figs 2-156 and 2-157)

(1) If pump is to be removed with the PTO, refer to paragraph 2-100. Otherwise, attach an optional eyebolt (if available) to the pump. Use a suitable lifting device for support, either around the pump or through the eyebolt.

(2) Provide a suitable container and splash plate to drain residue fluid during parts removal (less than one gallon). Position beneath work area. Disconnect two input lines (fig. 2-157), two output lines, and line attached to tee (fig. 2-158) that goes on to winch hydraulic pump. Plug all open lines to prevent system contamination. Remove pump fittings.

(3) Take up slack in lifting device. Remove two screws, lockwashers, and flat washers (fig. 2-156), securing pump flange to PTO.

(4) Pull pump straight out from PTO to free pump drive shaft from PTO drive shaft coupling, and then pull up and clear of vehicle. Assure that pump hoses are protected from damage during transfer of pump from vehicle.

c. Installation of Pump. Attach suitable lifting device, either around pump or through optional eyebolt.

(1) Hoist pump above vehicle and slowly lower into position, observing caution around all pump lines.

(2) Place gasket between pump and PTO flange.

(3) Slowly insert pump drive shaft through gasket into PTO until gears mesh with PTO drive coupling.

(4) Secure pump by installing two screws, lock-

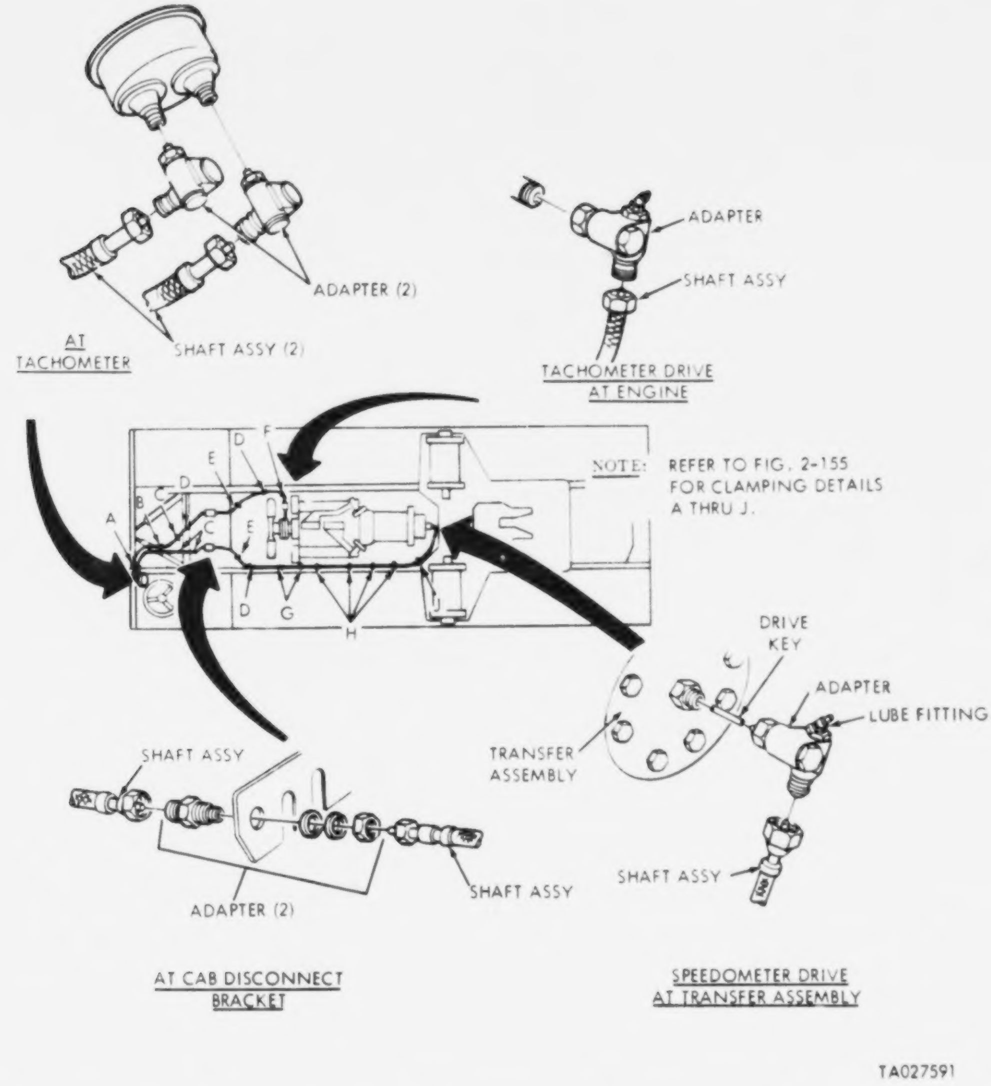

ADAPTER (2)
SHAFT ASSY (2)
AT TACHOMETER
ADAPTER
SHAFT ASSY
TACHOMETER DRIVE AT ENGINE
NOTE: REFER TO FIG. 2-155 FOR CLAMPING DETAILS A THRU J.
A
B
C
D
E
F
G
H
J
DRIVE KEY
ADAPTER
LUBE FITTING
TRANSFER ASSEMBLY
SHAFT ASSY
SHAFT ASSY
SHAFT ASSY
ADAPTER (2)
AT CAB DISCONNECT BRACKET
SPEEDOMETER DRIVE AT TRANSFER ASSEMBLY
TA027591

Figure 2-154. Removal or installation of speedometer and tachometer drive adapters and shaft assemblies.

washers, and flat washers at flange into PTO.

(5) Replace packing, if required. Install fittings into pump. Remove line plugs and install open lines onto fittings.

d. Replacement of Hose Assemblies (fig. 2-157).

NOTE

Draining of transmission and transfer oil is not necessary for replacement of lube and scavenge pump hose assemblies.

(1) Provide a suitable container and splash plate to drain residue oil (less than one gallon) during parts removal. Position beneath work area. Disconnect hose assembly at fitting at each end. If pump fittings are removed, inspect preformed packing for wear or damage. Replace if necessary.

(2) Install hose assembly by connecting hose assembly at fittings at each end. Add oil as required.

2-100. Transfer Assembly Lube and Scavenge Pump PTO Fig. 2-156

NOTE

To remove the PTO and lube and scavenge pump as one unit, attach an optional eyebolt (if available) to the pump. Use a suitable lifting device for support, either around the pump or through the optional eyebolt. If pump is to be removed separately, refer to paragraph 2-99.

a. Removal.

(1) Provide a suitable container and splash plate to drain residue fluid during parts removal. Position

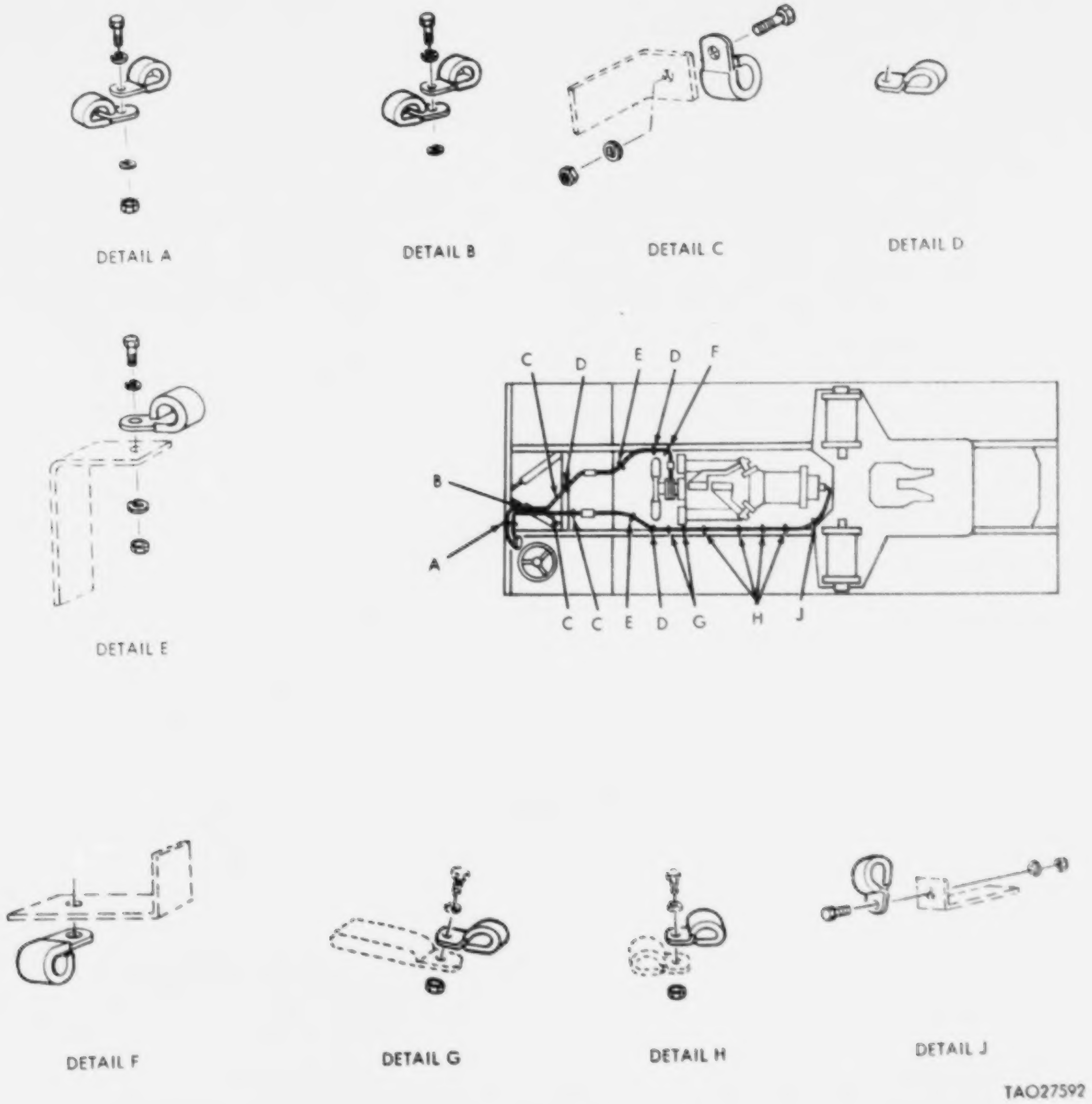


Figure 2-155. Speedometer and tachometer shaft assembly clamping details.

beneath work area. Disconnect pump discharge and supply hoses. Seal open ends. Disconnect and plug oil tube at PTO. Remove pump fittings.

(2) Attach suitable lifting device to pump eyebolt and take up slack in lifting lines.

(3) Remove six screws and lockwashers securing PTO to adapter plate.

(4) Pull PTO from adapter plate on transmission and continue pulling unit about three inches away to free PTO idler gear.

(5) Lift straight up and clear of vehicle. Assure that pump hoses are protected from damage during transfer of pump and PTO from vehicle.

(6) Separate pump and PTO by removing two screws and lockwashers from pump and PTO mating flanges. Remove oil tube fitting from PTO.

b. Installation.

(1) Remove gasket and clean gasket surface of PTO and transmission housing.

(2) Install oil fitting on PTO.

(3) Install gasket between pump and PTO if pump was removed.

(4) Attach pump to PTO (if pump was removed) by installing two screws, lockwashers and flatwashers into mating flange.

(5) Install PTO gasket on adapter plate and apply gasket sealer to prevent oil leaks.

(6) Lower PTO and pump (or PTO alone if pump was not removed) into position using hoist chain or

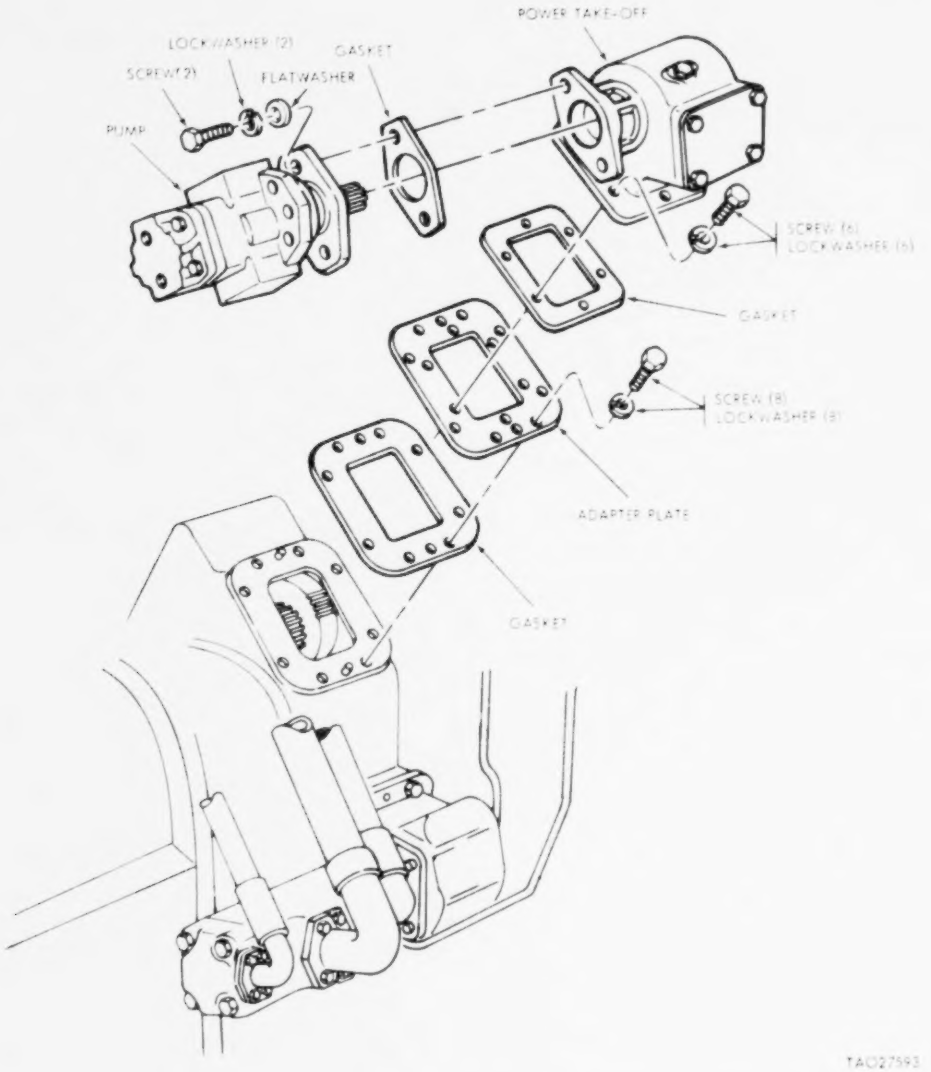

POWER TAKE-OFF
LOCKWASHER (2)
GASKET
SCREW (2)
FLATWASHER
PUMP
SCREW (6)
LOCKWASHER (6)
GASKET
SCREW (8)
LOCKWASHER (8)
ADAPTER PLATE
GASKET
TA027593

Figure 2-156. Removal or installation of oil scavenge/lube pump and power takeoff

sling. Turn PTO gear by hand to align gear with transmission mating gear.

(7) Install six screws and lockwashers and secure pump to housing.

NOTE

Torque nuts to 30-35 lb-ft for six hole assemblies and 50-55 lb-ft for eight hole assemblies.

(8) Remove plug from open tube and connect to PTO.

(9) If pump is installed, remove plugs from open hoses and connect to pump. If pump is not installed, refer to paragraph 2-99.

CAUTION

After the installation of the PTO and pump is completed, start the engine. If a whine is heard from the PTO unit, a second gasket must be added between the PTO and adapter plate and reinstall. Do not stack more than four gaskets together.

(10) Check transmission oil level. Add if required. Check for oil leaks.

NOTE

When a new PTO is installed, unit is packaged with gasket set (.010 and .020), studs, screws, nuts, and instructions.

2-101. Winch Power Take Off Fig. 2-158

NOTE

The winch power takeoff and winch hydraulic pump can be taken off as one unit. An eyebolt is provided on the PTO for lifting from the vehicle with a sling. If pump and PTO are removed as a unit, use a rope sling for support around the pump and through the eyebolt.

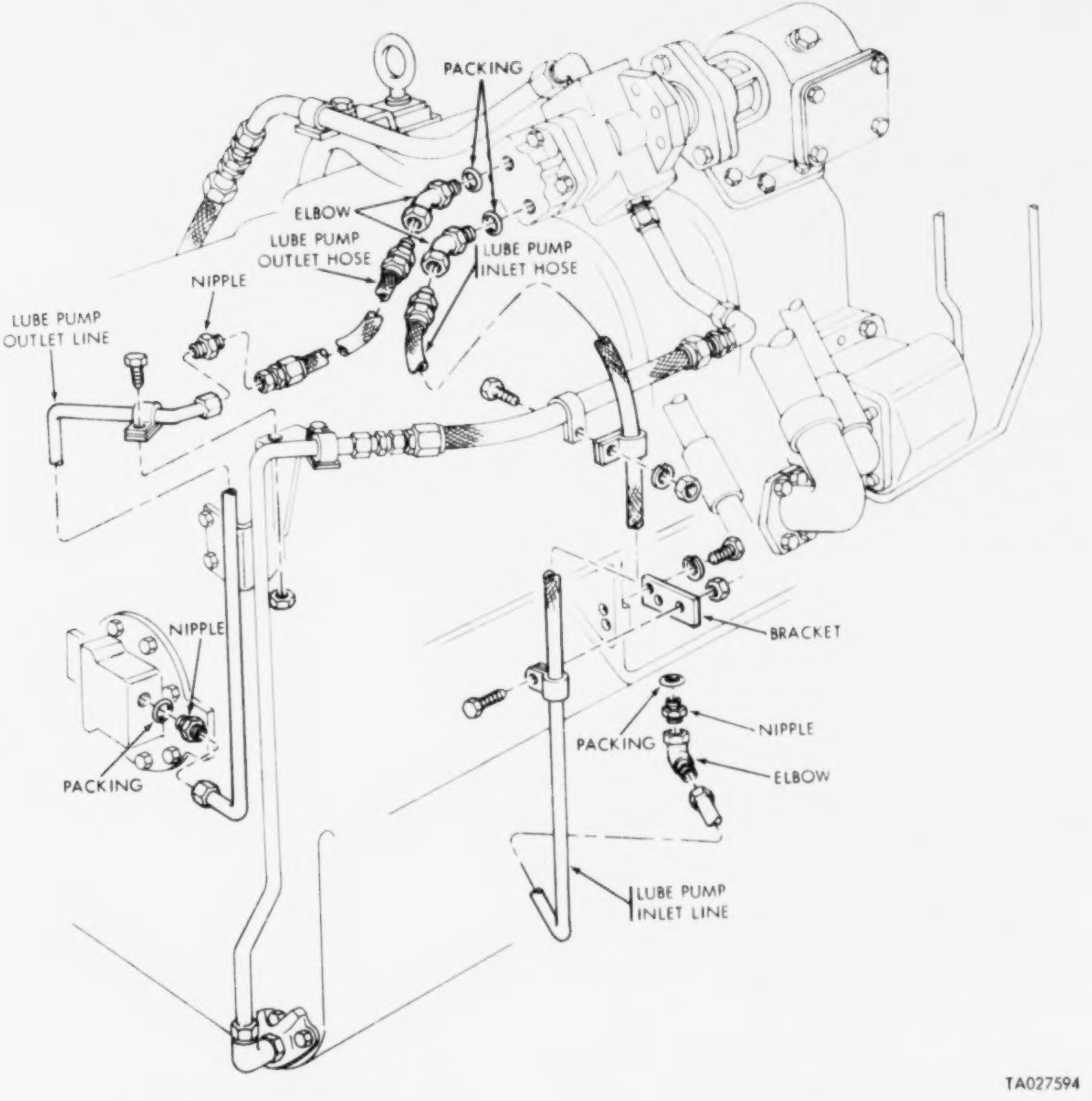

PACKING
ELBOW
LUBE PUMP OUTLET HOSE
LUBE PUMP INLET HOSE
NIPPLE
LUBE PUMP OUTLET LINE
NIPPLE
BRACKET
PACKING
NIPPLE
ELBOW
PACKING
LUBE PUMP INLET LINE
TA027594

Figure 2-157. Removal or installation of transfer lube/scavenge pump hose and tube assemblies (1 of 2).

a. Removal.

(1) If pump is to be removed separately, refer to paragraph 2-176 for pump removal. Otherwise, disconnect pump discharge and supply hoses. Disconnect and plug three oil tubes at power takeoff.

(2) Attach suitable lifting device to lifting bracket on pump and take up slack in lines.

(3) Remove seven nuts and lockwashers securing power takeoff to transmission housing.

(4) Pull power takeoff from studs and dowel pins and continue pulling unit away about three inches from transmission housing to free PTO idler gear. Lift unit straight up and clear of vehicle. Assure that pump hoses are protected from damage during transfer of pump and PTO from vehicle.

(5) Separate pump and power takeoff by removing two screws and lockwashers from pump and PTO mating flanges. Remove oil tube fittings from PTO.

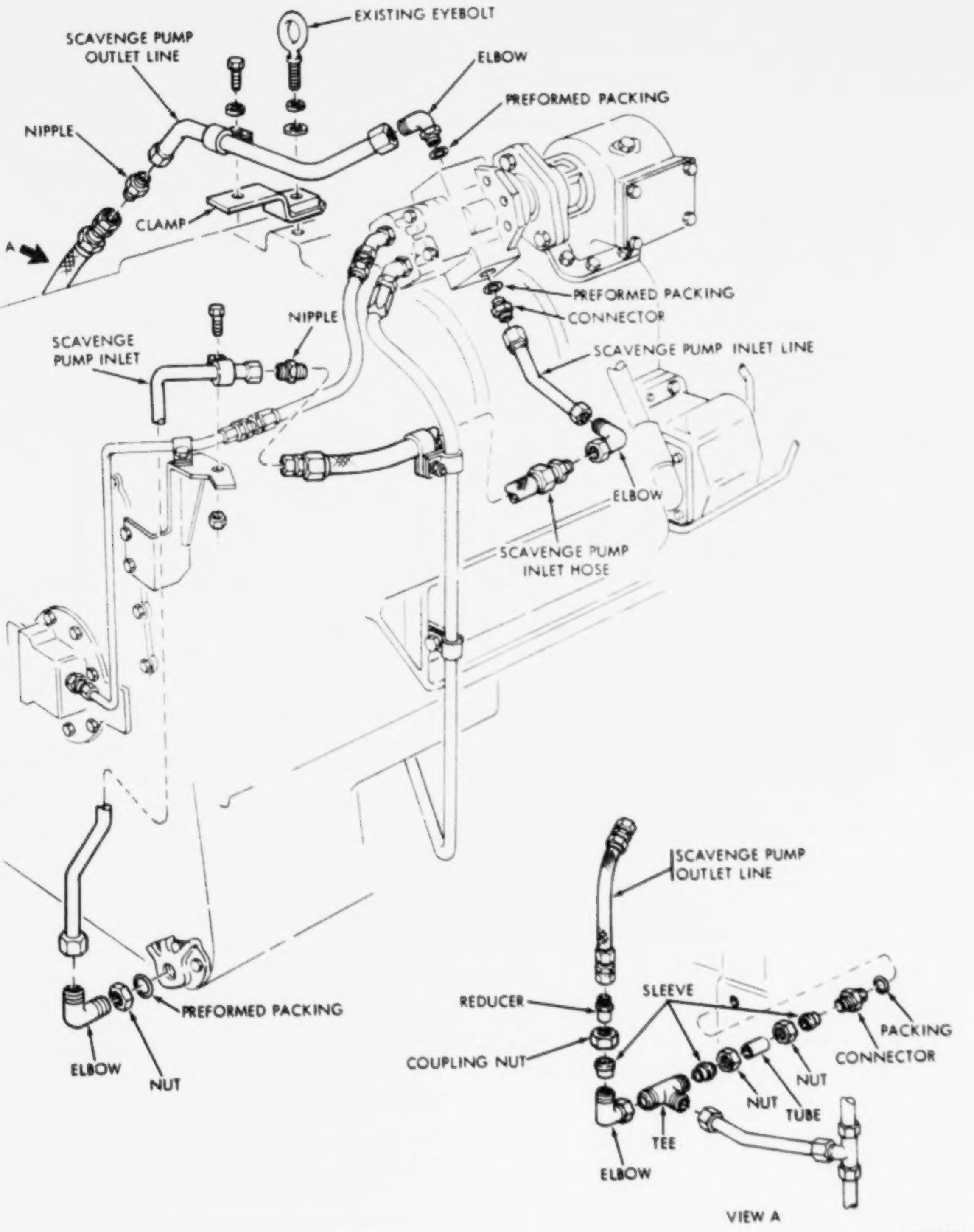

EXISTING EYEBOLT
SCAVENGE PUMP OUTLET LINE
ELBOW
PREFORMED PACKING
NIPPLE
CLAMP
A
PREFORMED PACKING
CONNECTOR
NIPPLE
SCAVENGE PUMP INLET
SCAVENGE PUMP INLET LINE
ELBOW
SCAVENGE PUMP INLET HOSE
PREFORMED PACKING
ELBOW
NUT
SCAVENGE PUMP OUTLET LINE
REDUCER
SLEEVE
COUPLING NUT
PACKING
CONNECTOR
NUT
NUT
TUBE
TEE
ELBOW
VIEW A
TA027595

Figure 2-157. Removal or installation of transfer lube/scavenge pump hose and tube assemblies (2 of 2).

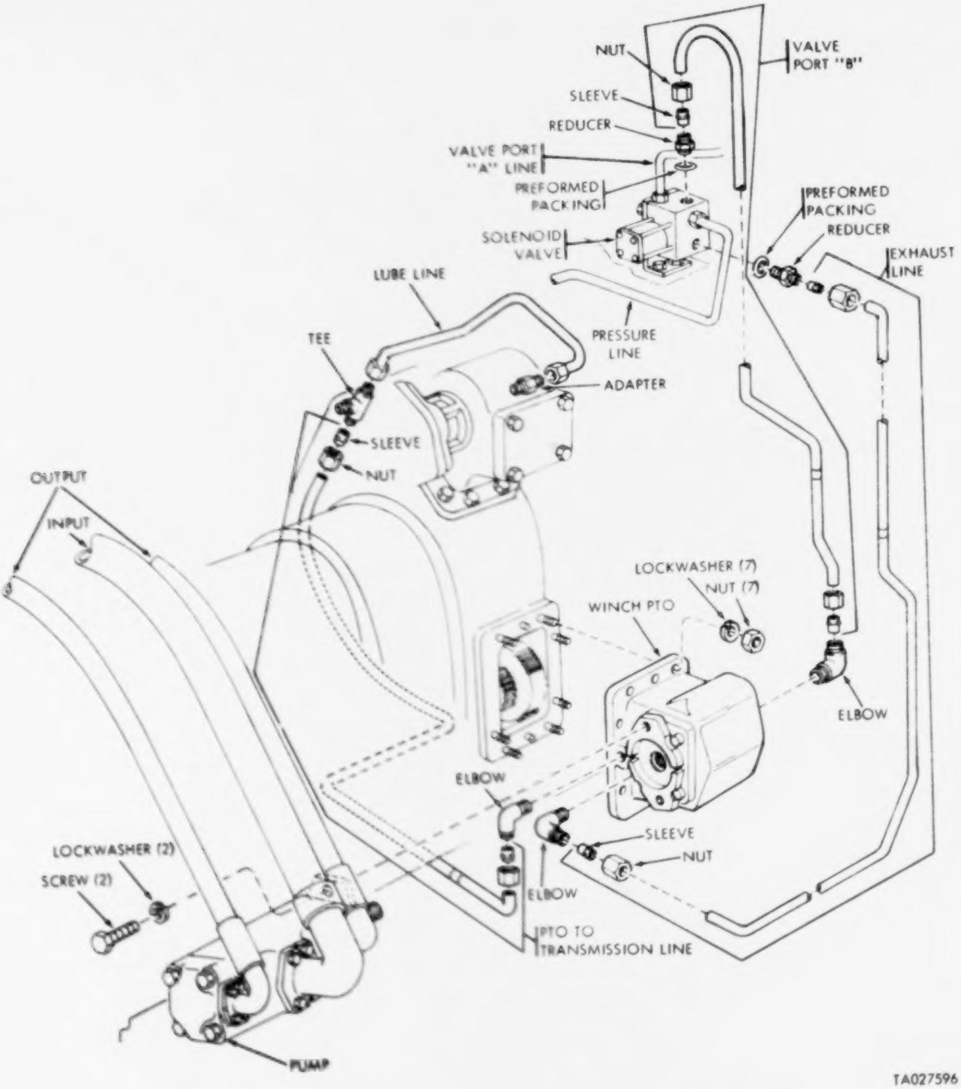

NUT
VALVE PORT "B"
SLEEVE
REDUCER
VALVE PORT "A" LINE
PREFORMED PACKING
SOLENOID VALVE
PREFORMED PACKING
REDUCER
EXHAUST LINE
LUBE LINE
TEE
PRESSURE LINE
ADAPTER
SLEEVE
NUT
OUTPUT
INPUT
LOCKWASHER (7)
NUT (7)
WINCH PTO
ELBOW
ELBOW
SLEEVE
NUT
ELBOW
LOCKWASHER (2)
SCREW (2)
PTO TO TRANSMISSION LINE
PUMP
TA027596

Figure 2-158. Removal or installation of winch power takeoff assembly.

b. Installation.

(1) Remove gasket from PTO and transmission housing and clean gasket surface.

(2) Replace damaged studs.

(3) Install .010 PTO gasket with gasket sealer to prevent leaks.

(4) Install oil tube fittings on PTO.

(5) Install gasket between pump and flange if pump was removed.

(6) Lower power takeoff (alone or with pump) into position using hoist chain or sling. Turn PTO gear by hand to align gear with transmission mating gear. Position over transmission opening.

(7) Install seven nuts and lockwashers on eight hole PTO or six nuts and lock washers on six hole PTO. Torque nuts on eights hole PTO to 50-55 lb.-ft., and to 30-35 lb.-ft. on six hole PTO. Tighten nuts evenly.

(8) Remove plugs from tubes and connect to PTO.

(9) If pump is installed with PTO, connect pump hoses; if not, refer to para 2-176*b*.

CAUTION

When winch PTO and pump have been installed, start engine. If a whine is noted from PTO unit, a second .010 gasket must be added. Do not stack more than four gaskets together.

(10) Check transmission oil level. Add if necessary. Also check for oil leaks from PTO, winch pump, fittings and oil hoses.

2-102. Winch PTO Solenoid Fig. 2-159

a. Removal of solenoid. Disconnect and plug four tube assemblies from solenoid manifold. Disconnect electrical connectors. Remove four screws securing solenoid to engine and remove solenoid. Remove four reducers and two plugs from solenoid.

b. Installation of solenoid. Install four reducers and two plugs in solenoid. Position solenoid and install four screws to secure solenoid to engine. Connect electrical connectors. Unplug and connect four tube assemblies to solenoid manifold.

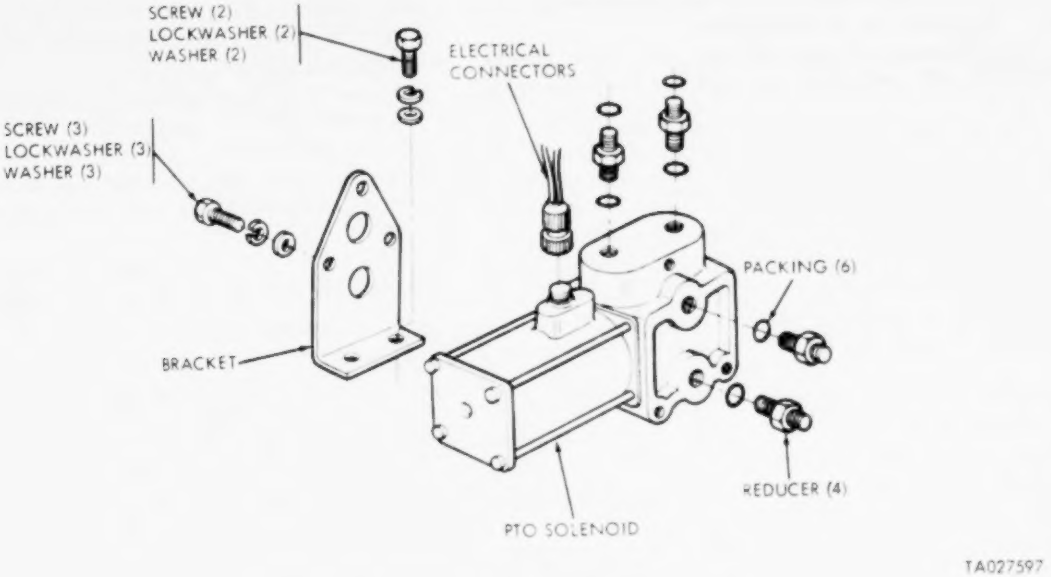

SCREW (2)
LOCKWASHER (2)
WASHER (2)
ELECTRICAL CONNECTORS
SCREW (3)
LOCKWASHER (3)
WASHER (3)
PACKING (6)
BRACKET
REDUCER (4)
PTO SOLENOID
TA027597

Figure 2-159. Removal or installation of PTO solenoid.

c. Removal of Winch Oil Line Parts.

(1) To replace parts between reservoir and winch pump suction line, drain contents of reservoir into suitable *clean* container such as an empty oil drum. Disconnect part and remove. Cap all open fittings to prevent contamination.

(2) To replace other parts, provide a suitable container and splash plate to drain residue fluid (less than one gallon) during parts removal. Position beneath work area. Disconnect part and cap all open fittings to prevent system contamination.

d. Installation of Winch Oil Line Parts.

(1) Connect parts between reservoir and winch pump suction line and uncap fitting previously sealed.

(2) Discard residue oil.

(3) If oil drained from reservoir during suction line removal appears dirty or contaminated, refill with new engine oil OE-10, MIL-L-2104. Check oil level after completion of work and bleed air from system.

2-103. Transmission Breather Vent
Fig. 2-160

Unscrew breather and clean thoroughly by shaking breather in a container of dry-cleaning solvent. Replace breather mounting parts as required.

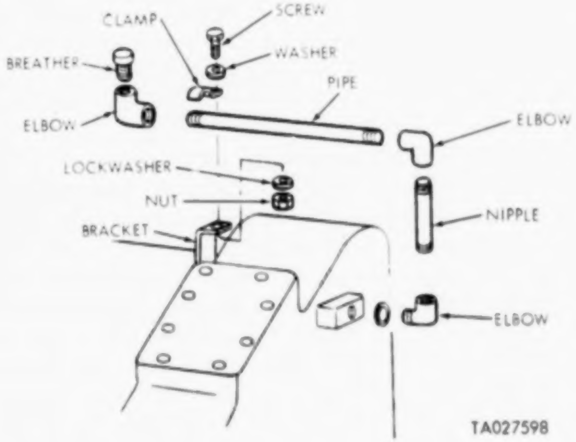

CLAMP
SCREW
BREATHER
WASHER
PIPE
ELBOW
ELBOW
LOCKWASHER
NUT
BRACKET
NIPPLE
ELBOW
TA027598

Figure 2-160. Transmission breather vent removal.

Section XVII. PROPELLER SHAFTS

2-104. Removal of Propeller Shafts Fig. 2-161

CAUTION

Before the M746 tractor is towed by another vehicle, the propeller shafts at the transfer assembly must be disconnected from the transfer drive yokes; otherwise, sever damage may occur to the power plant.

a. Removal of Intertandem Propeller Shafts. Remove four nuts securing propeller shaft universal joint at transfer case yoke. Remove four nuts securing propeller shaft universal joint at carrier yoke. Support propeller shaft and remove screws from which nuts were taken. Remove propeller shaft from vehicle.

b. Removal of Interaxle Propeller Shafts. Support propeller shaft and remove four screws and lockwashers (inset, fig. 2-161) securing each propeller shaft universal joint to axle carrier yoke. Remove propeller shaft from vehicle.

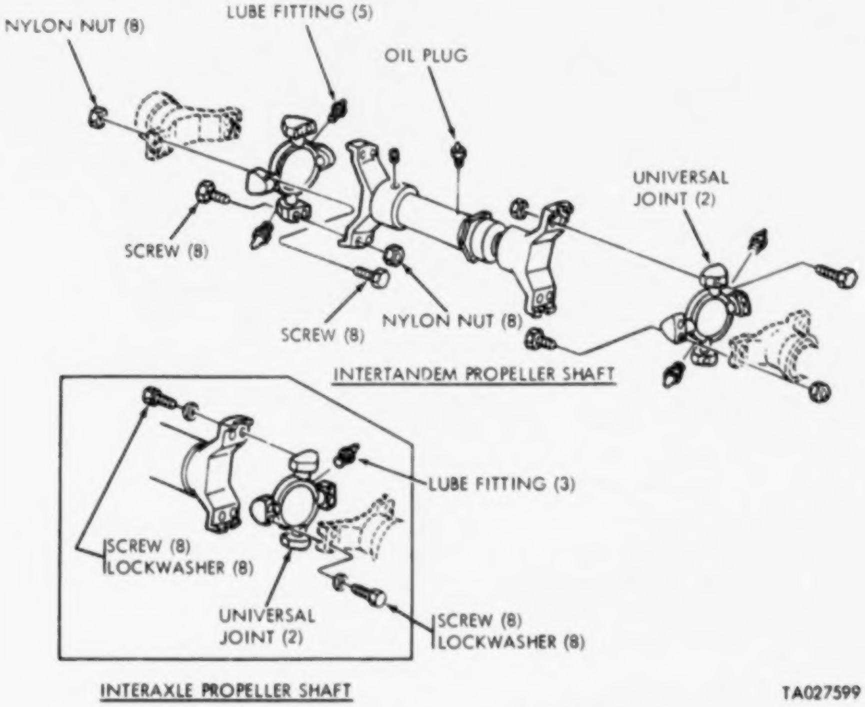


Figure 2-161. Removal or installation of propeller shafts.

2-105. Repair of Propeller Shafts

a. Inspection. Check each universal joint assembly for looseness on propeller shaft. Universal joint should pivot readily on bearings, but should have no end play against the bearings. Leakage of lubricant from threaded seal cap is evidence of worn or damaged seals. Unscrew cap and inspect seals. Check to see that all lube fittings are in place: two on each intertandem universal joint, 180 degrees apart, one in each interaxle universal joint, and one on each propeller shaft tube. If propeller shaft is broken or bent, discard and replace.

b. Repairing. If bearings show evidence of wear, remove and replace universal joint assembly. Do not attempt to replace bearings individually. If seals need replacing, unscrew seal cap, separate shaft, and remove seals. After new seals are installed, reassemble shaft parts so that alining arrows stamped on tube and shaft are in line. Lubricate propeller shaft following LO 9-2320-258-12. Replace universal joint assemblies as required: Remove four nylon nuts and four screws from each end of propeller shaft. Remove universal joint. Install new universal joint using four screws and nylon nuts. Do not remove or break lockwire welded between bearing sets. Lube fittings on either side of propeller shaft should be alined for proper installation of universal joints.

2-106. Installation of Propeller Shafts

Install intertandem propeller shaft using four screws and nuts at each yoke connection. Tighten screws to 90-100 lb.-ft. torque. Tighten nuts on screws to 50-60 lb.-ft. torque. Install interaxle propeller shaft by using four screws and lockwashers at each yoke connection. Tighten screws to 70-80 lb.-ft. torque.

Section XVIII. FRONT AXLES

2-107. Description and Data

a. Description. Both front axles of the M746 truck tractor are driving axles with steerable wheels. Power from the vehicle power plant is transferred to the differential carrier on each axle assembly by universally jointed propeller shafts. Each axle assembly is equipped with a double gear-reduction drive unit, which transfers power to the axle shaft assemblies, which drive the wheels. The axle shaft constant velocity (CV) joints, located in each case between the axle housing and the wheels, permit the front wheels to be steered. An intertandem differential, part of the transfer assembly, allows independent use of engine torque by each tandem assembly and allows each tandem to turn at a rate different from the other.

b. Data. Refer to paragraph 1-7,

2-108. Scheduled Front Axle Maintenance

a. General. Scheduled front axle maintenance consists of the disassembly, cleaning, inspection, lubrication, and assembly of the following items: (1) hub assemblies (para 2-130), (2) brakes (para 2-119), and (3) trunnion socket assemblies and CV joints (*b* below). In addition, axle differential oil is checked, drained, and filled (LO 9-2320-258-12).

b. Disassembly, Service, and Assembly of Front Axle Outer End (figs. 2-162 through 2-166).

(1) Jack up and support front tandem axles so that wheels are raised completely off of ground and axle is in horizontal position.

(2) Remove wheel (para 2-129).

NOTE

Wheel, hub, and drum may be removed as an assembly.

(3) Remove hub and drum assembly (para 2-130).

(4) Drain air system. Remove brake shoes (para 2-119*a*).

(5) Drain lubricant from axle into suitable container by removing drain plug (18, fig. 2-162).

(6) Remove 12 nuts (13) and washers (14) and remove dust shield (15) and spindle (16). Inspect condition of CV joint lubricant. If evidence of rust or contamination exists, especially if CV joint rubber boot has been torn, the CV joint must be repacked by hand.

(7) Remove screw (4) with lube fitting and nut (11). Detach tie rod yoke (3) from knuckle and trunnion socket assembly (7).

(8) Detach ball and socket assembly from knuckle steering arm.

NOTE

Proceed to (9) below only if CV joint is to be repacked by hand; otherwise, proceed to (15) below.

(9) Remove axle shaft assembly (17) from axle. Inspect cavity of trunnion socket for evidence of oil leaking past the seal at the throat of trunnion socket. If oil is present (picked up on finger tips), the seal may have to be replaced. Inspect seal further (9 below). Inspect axle shaft assembly for damage to splines, heavy scoring on bell portion, gouges in area that mates with oil seal, or heavy wear in bell and cage area (indicated by lateral free play). If any of these conditions exist, replace axle shaft assembly. Otherwise proceed to (10) below.

NOTE

Items called out by number below refer to figure 2-162.

(10) Inspect CV joint rubber boot (26). If boot shows evidence of leaking lubricant or of damage, remove boot guard and detach boot outer lip by removing 12 screws (23), lockwashers (24), and two retaining clamps (25). Unfold boot. If damage is found, replace boot. If not, inspect further: wipe boot clean. Inspect for tears, punctures, cracking, or generally deteriorated condition. Replace boot if damage is found (para 2-109). Use split boot only if trunnion socket assembly is not to be removed.

(11) Grasp knuckle of trunnion socket assembly with both hands and try rocking knuckle vertically on trunnion socket. Obvious vertical rocking freeplay (more than 1/64 inch) indicates faulty condition; either internal parts are badly worn, shim thickness at pins is inadequate, or cap and pin assemblies are not secure on knuckle. Tighten screws on cap and pin assemblies (and/or steering arm) and recheck end play of knuckle. If excessive end play persists, disassemble trunnion socket assembly and replace worn parts and/or readjust (para 2-110). Otherwise, wipe trunnion socket inside surface clean of old grease using cleaning solvent. Check surface for scratches or scoring. Inspect oil seal (9) and runout limiter bushing (8) for damage or distortion (use flashlight if necessary). If any of the above are found, replace damaged parts (para 2-110).

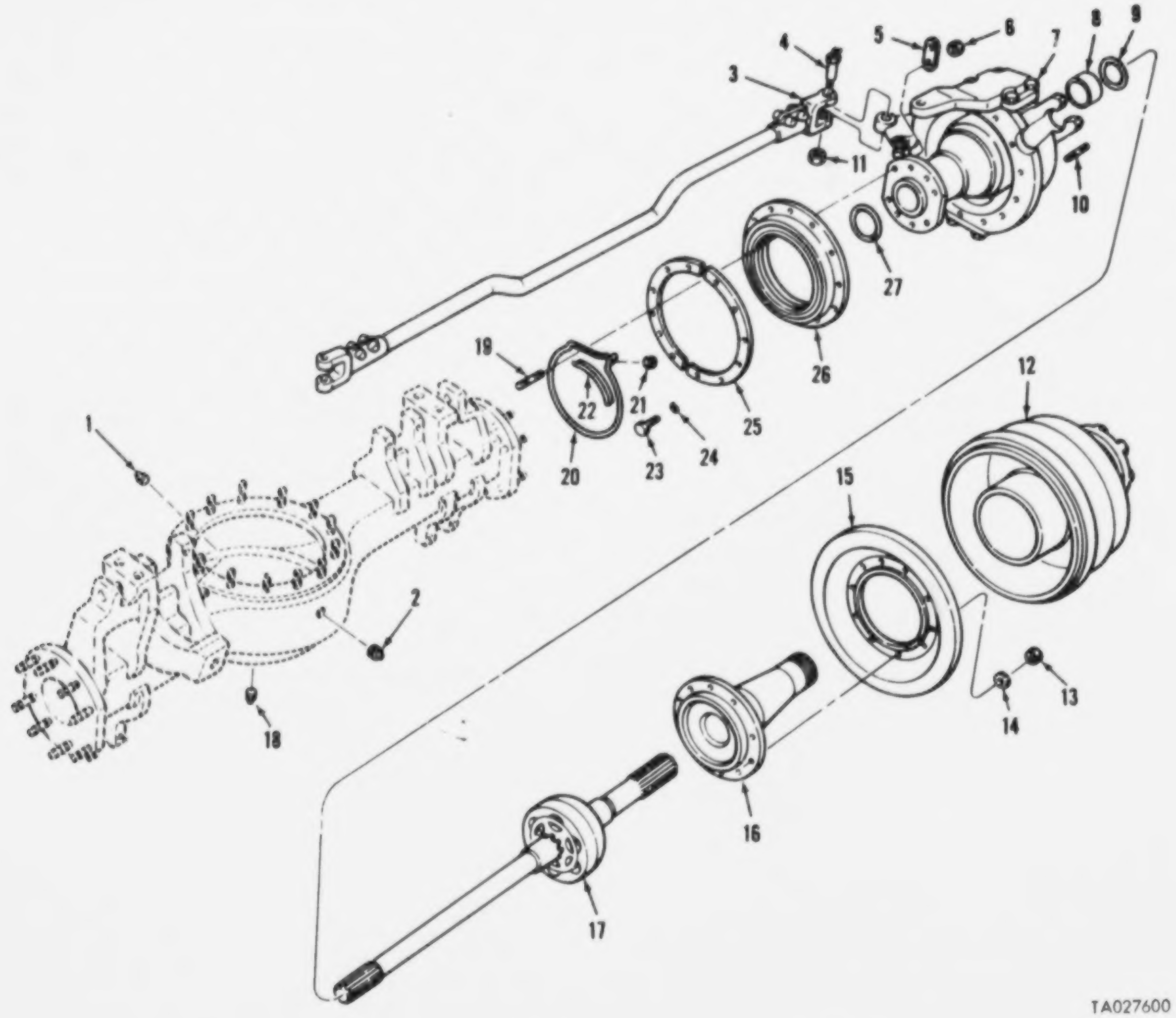
(12) Clean old grease from trunnion socket assembly under rubber boot and coat metal surfaces with grease GAA. Grease coat socket inside surface ¼ to ½ inch thick with grease GAA.

(13) Attach boot (26) outer lip to knuckle by installing retaining clamp and 12 screws (23) and lockwashers (24).

(14) Hand pack universal joint assembly by forcing grease GAA into bell and race cavities. Insert axle shaft assembly (17) through trunnion socket oil seal. Guide axle shaft assembly into axle housing and into side gear of drive unit. Rotate shaft assembly to engage splines of shaft with side gear.

(15) Inspect studs (10) on knuckle for damage. Slight damage to threads can be corrected with fine mill file. Replace studs that have badly damaged threads or that are fractured.

(16) Install spindle (16) and dust shield (15) using 12 nuts (13) and washers (14). Slot on spindle flange must



1 Air line fitting
2 Pipe plug
3 Yoke, tierod
4 Screw,w/fitting
5 Bracket
6 Nut (8)
7 Trunnion socket assembly
8 Run-out limiter bushing
9 Oil seal
10 Stud
11 Nut
12 Hub and drum assembly
13 Nut (12)
14 Washer (12)
15 Dust shield
16 Spindle
17 Axle shaft assembly
18 Plug, magnetic
19 Stud (8)
20 Wire ring
21 Nut
22 Sleeve
23 Screw (12)
24 Lockwasher (12)
25 Clamp, boot retaining (2)
26 Boot
27 Packing, preformed

Figure 2-162. Front axle outer end—partially exploded view.

be on bottom. Tighten 12 nuts to 130-167 lb.-ft. torque.

(17) Attach tie rod yoke (3) to knuckle using special screw (4) with lube fitting and nut (11). Tighten nut to 165-180 lb.-ft. torque.

(18) Attach ball and socket (on reach rod) to knuckle steering arm.

(19) Service brake actuator, if required, and install brake shoes (para 2-119).

(20) Service and install hub and drum assembly (para 2-130).

(21) Install wheels (para 2-129).

(22) Remove supports and lower front tandem axles.

2-109. Replacement of CV Joint Boot

Fig. 2-163

NOTE

If trunnion socket remains on axle, remove boot guard (partially covering boot), remove old boot and replace with split boot. Close boot zipper by hand after positioning boot on trunnion socket. Install boot using new wire ring (20, fig. 2-132).

Discard old ring. Clip end of wire ring after nut (21) is installed.

a. Removal

NOTE

Items called out by number in this sequence refer to figure 2-162.

If not previously done, remove 12 screws, 12 lockwashers, and two boot retaining clamps (25). Unfold boot (26) and loosen nut (21) on wire ring (20) that clamps boot in trunnion socket groove. Be sure that sleeve (22) is not lost. Remove boot (26) from trunnion socket.

b. Installation.

NOTE

Install solid CV joint boot after trunnion socket assembly has been reassembled.

NOTE

A clean, dry surface in the area of the trunnion socket boot groove is a necessity for easy installation of boot.

(1) Clean groove area of trunnion socket using cleaning solvent. Wipe dry.

(2) Stand trunnion socket assembly upright with knuckle down. Use supporting blocks or wood wedges under socket end to maintain trunnion socket upright in knuckle.

(3) Position new boot over trunnion socket. Using both hands, place boot lip in groove at spot between heels of hands. Maintain lip in groove by applying slight pressure forward. Slide hands around boot and guide lip into groove (A, fig. 2-163) until boot lip is completely seated.

(4) Carefully unfold boot (B, fig. 2-163) without unseating boot lip from groove.

(5) Position new wire ring over boot lip and position sleeve behind ring at lock point. Position ring threaded end in eye of ring and install nut (C, fig. 2-163). Trim excess wire beyond nut with snippers.

(6) Using grease GAA, coat metal surfaces of trunnion socket and knuckle to be covered by boot.

(7) Collapse boot and aline holes in boot flange with holes in knuckle (it may be necessary to loosen nut on wire ring and turn boot in groove). Position two retaining clamps (25) on boot flange and install 12 screws and lockwashers (23 and 24) (fig. 2-162).

(8) Inspect studs (19) on axle housing for damage. Replace if necessary (fig. 2-162).

NOTE

To prevent water from bypassing the spline and contaminating the bearings, seal the spline end of the universal joint assembly with adhesive NSN 8040-00-148-7207.

(9) Replace O-ring (27) and install trunnion socket assembly (7) on axle. Install air fitting bracket (5) on upper right corner of trunnion socket flange while installing nuts (6) (fig. 2-162).

2-110. Removal, Disassembly, Inspection, Assembly, Installation, and Adjustment of Trunnion Socket Assembly

a. Removal. Trunnion socket assembly may be disassembled while trunnion socket is attached to axle (*b* below); otherwise remove nuts (6, fig. 2-162) and remove socket assembly.

b. Disassembly.

(1) After front axle outer end has been partially disassembled (para 2-108*b* (1) through (9)), detach CV joint boot (para 2-109).

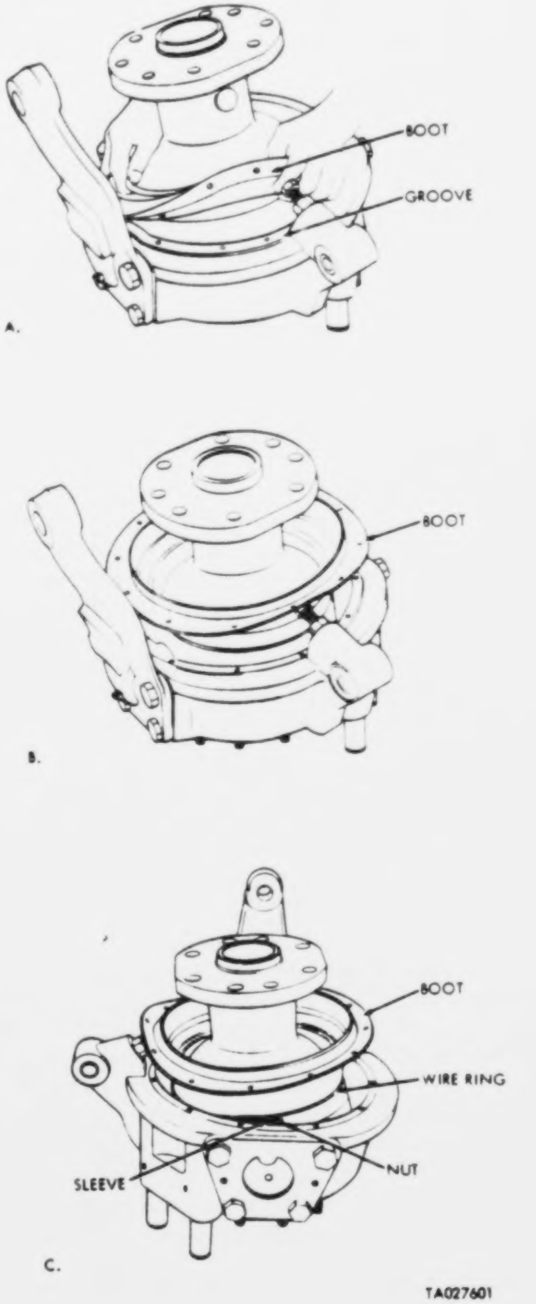


Figure 2-163. Installation of boot in trunnion socket groove.

(2) Check end play of steering knuckle (para 2-108*b*(11)).

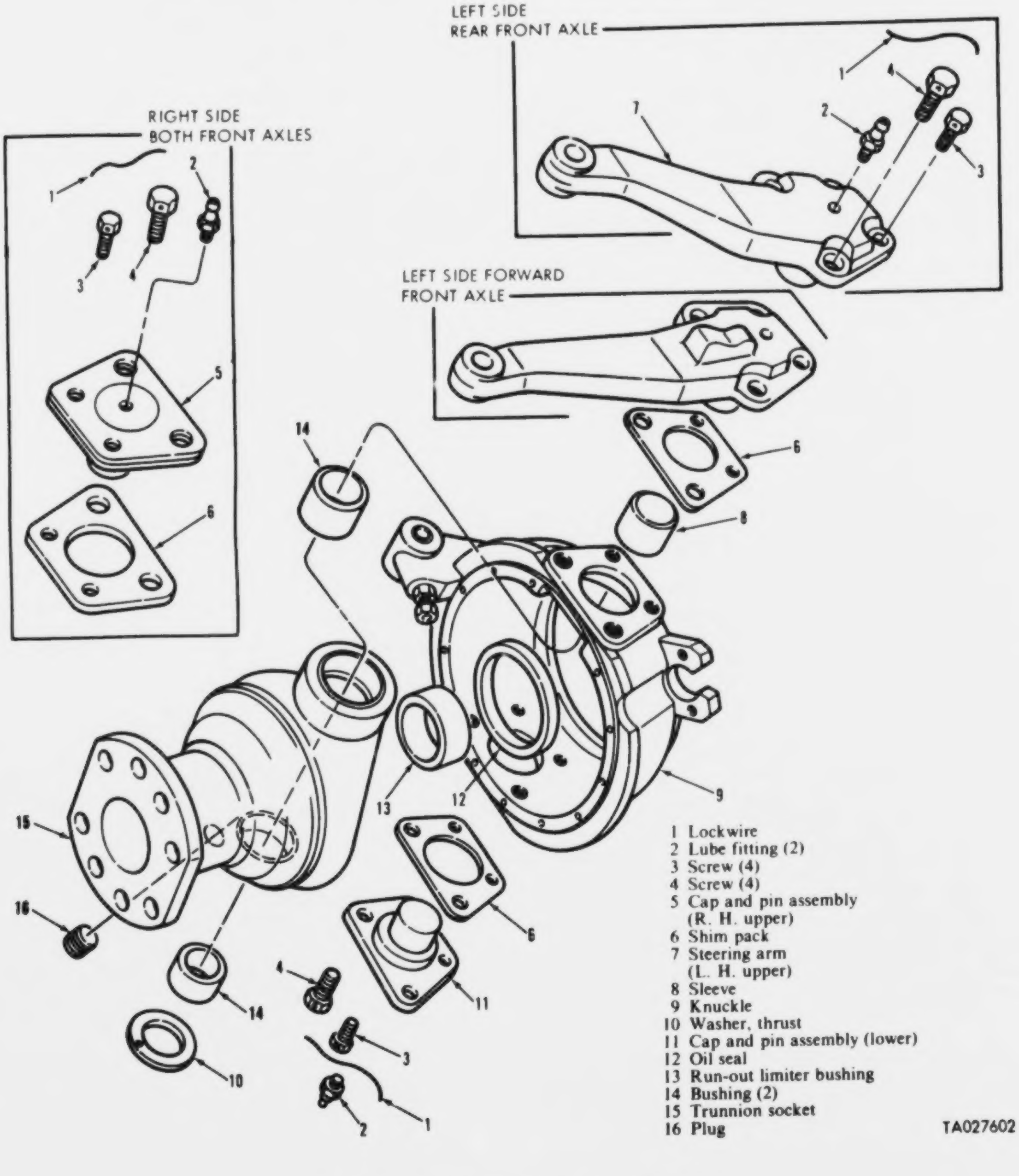
(3) Right axle trunnion socket assemblies use two cap and pin assemblies (5 and 11). Left side trunnion socket assemblies use one steering arm (7) and one cap and pin assembly (11). Remove lockwire (1) and two each of two screws (3 and 4) from upper and lower pin assembly (5 and 11 or 7 and 11), and remove assemblies with shim pack (6) from knuckle (9) (fig. 2-164).

(4) Remove sleeve (8) from steering arm (7) or knuckle bore.

(5) Pivot knuckle (9) laterally, and rearward, approximately 45 degrees off center, and lift knuckle off top of trunnion socket (15). Remove knuckle (9).

(6) Remove trunnion socket (15) by removing eight nuts securing trunnion socket to axle housing. Remove trunnion socket.

(7) If parts are damaged, carefully remove oil seal (12) and run-out limiter bushing (13) from trunnion socket.



1 Lockwire
2 Lube fitting (2)
3 Screw (4)
4 Screw (4)
5 Cap and pin assembly
(R. H. upper)
6 Shim pack
7 Steering arm
(L. H. upper)
8 Sleeve
9 Knuckle
10 Washer, thrust
11 Cap and pin assembly (lower)
12 Oil seal
13 Run-out limiter bushing
14 Bushing (2)
15 Trunnion socket
16 Plug

Figure 2-164. Trunnion socket assembly — exploded view.

c. Inspection. Perform cleaning and inspection of disassembled parts. Inspect bushings in trunnion socket bores for obvious excessive wear, scoring, gouging, or loss of bearing surface metal. Remove bushings using suitable puller if damage is found, and install new bushings as in *d* below. Inspect trunnion socket inside socket surface for scratches or scoring. Inspect trunnion socket i.d. wall where seal (12) seats (fig. 2-164) for gouges that would allow oil by-pass. Replace damaged trunnion socket. Inspect cap and pin assemblies and/or steering arm for damage or visible wear to the pin o.d. surface or end face. Inspect steering arm sleeve (8) for visible wear and replace, if necessary. Replace trunnion socket if upper and lower flats are worn to a rounded condition.

d. Assembly.

(1) Install new bushings (14) in trunnion socket (15), if required.

(a) Support trunnion socket at narrow end so that flat of socket end rests flush on pounding surfaces.

(b) Position bushing (14) on edge of socket pin bore. Drive in squarely using hammer and flat metal plate.

(c) Reverse trunnion socket and install opposite bushing using same procedure.

(2) Install axle shaft run-out limiter bushing (13) in trunnion socket using driver assembly CPR109380, with handle CPR109711, as shown in figure 2-165.

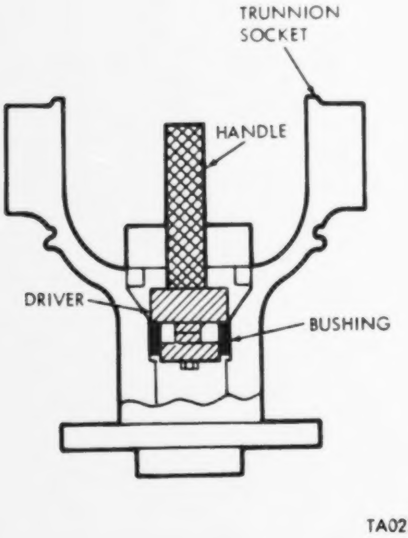


Figure 2-165. Using driver assembly CPR109380 to install run-out limiter bushing in trunnion socket.

(3) Install seal (12) in trunnion socket.

(a) Stand trunnion socket (socket up) on pounding surface.

(b) Position new seal (12) in trunnion socket and tap in squarely using driver assembly CPR109380, handle CPR109711, and hammer. Tap in until replacer bottoms against socket wall (fig. 2-166).

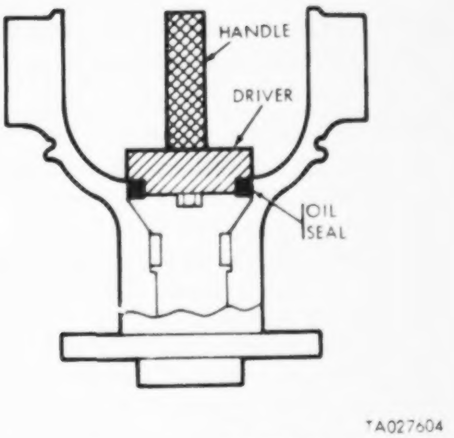


Figure 2-166. Using driver assembly CPR109380 to install trunnion socket oil seal.

NOTE

Items called out in following sequence refer to fig. 2-164.

(4) Install trunnion socket (15) in knuckle (9). (If trunnion socket remains on vehicle, install knuckle on trunnion socket in essentially the same but reverse manner.) Position knuckle (9) stud side down.

(5) Install sleeve (8) and steering arm (7) with shim pack (6) (or cap and pin assembly (5) with shim pack (6)) into upper pin bore of knuckle and of trunnion socket. Install two each of two screws (3 and 4). Tighten smaller screws (3) to 290-370 lb.-ft. torque. Tighten larger screws (4) to 510-655 lb.-ft. torque.

(6) Position thrust washer (10), shim pack (6), and cap and pin assembly (11) at knuckle and socket lower pin bores. Be sure that hole in thrust washer mates with dowel pin extending from trunnion socket. Secure cap and pin assembly (5) with two each of two screws (3 and 4). Tighten smaller screws (3) to 290-370 lb.-ft. torque. Tighten screws (4) to 510-655 lb.-ft. torque.

(7) Check adjustment of knuckle (9) on trunnion socket (15) (*f* below), adjust if necessary, and install lockwires (2) on screws (3 and 4).

e. Installation. Install trunnion socket assembly on vehicle using eight nuts (6, fig. 2-162). Tighten nuts to 510-655 lb.-ft. torque.

f. Adjustment.

(1) *Check Adjustment.* With narrow end of trunnion socket secured in vise (or on vehicle), try rocking knuckle vertically. The knuckle should have no more than 1/64-inch end play. Rotate the knuckle laterally on the pins - a small amount of drag should be felt but no binding should occur. Adjust if these conditions are not met.

(2) *Adjustment.* Add or remove shims between upper and lower caps until zero end play is established. Then, remove one 0.005-inch shim from each shim pack and reassemble upper and lower cap assemblies (*d*(5) and (6) above).

2-111. Axle Housing Drain and Fill Plugs

Replace axle housing drain and fill plugs (18 and 2, fig. 2-162) if damaged or lost.

2-112. Shock Absorbers, Axle Stop Cables, and Jounce Pads

Fig. 2-167

a. Shock Absorber.

(1) *Removal.* Remove nut and washer attaching each end of shock absorber to frame or axle bracket. Remove shock absorber.

(2) *Installation.* Install shock absorber by attaching each end of shock absorber to frame or axle bracket with nut and washer. Tighten each of two mounting nuts to 60-80 lb-ft torque.

b. Axle Stop Cable.

(1) *Removal.* Remove cotter pin and pin securing cable assembly to axle bracket. Remove nut and lockwasher securing cable anchor pin and cable at frame. Remove anchor pin. Remove pin from cable assembly.

(2) *Installation.* Install pin in cable assembly. Install anchor pin. Install nut and lockwasher securing cable anchor pin and cable to frame. Install cotter pin and secure cable assembly to axle bracket.

c. Jounce Pad.

(1) *Removal.* Remove two nuts, lockwashers, washers, and screws that secure pad to frame bracket. Remove pad.

(2) *Installation.* Position pad to frame bracket and secure by installig two nuts, lockwashers, washers, and screws. Tighten mounting nuts to 35 lb-ft torque.

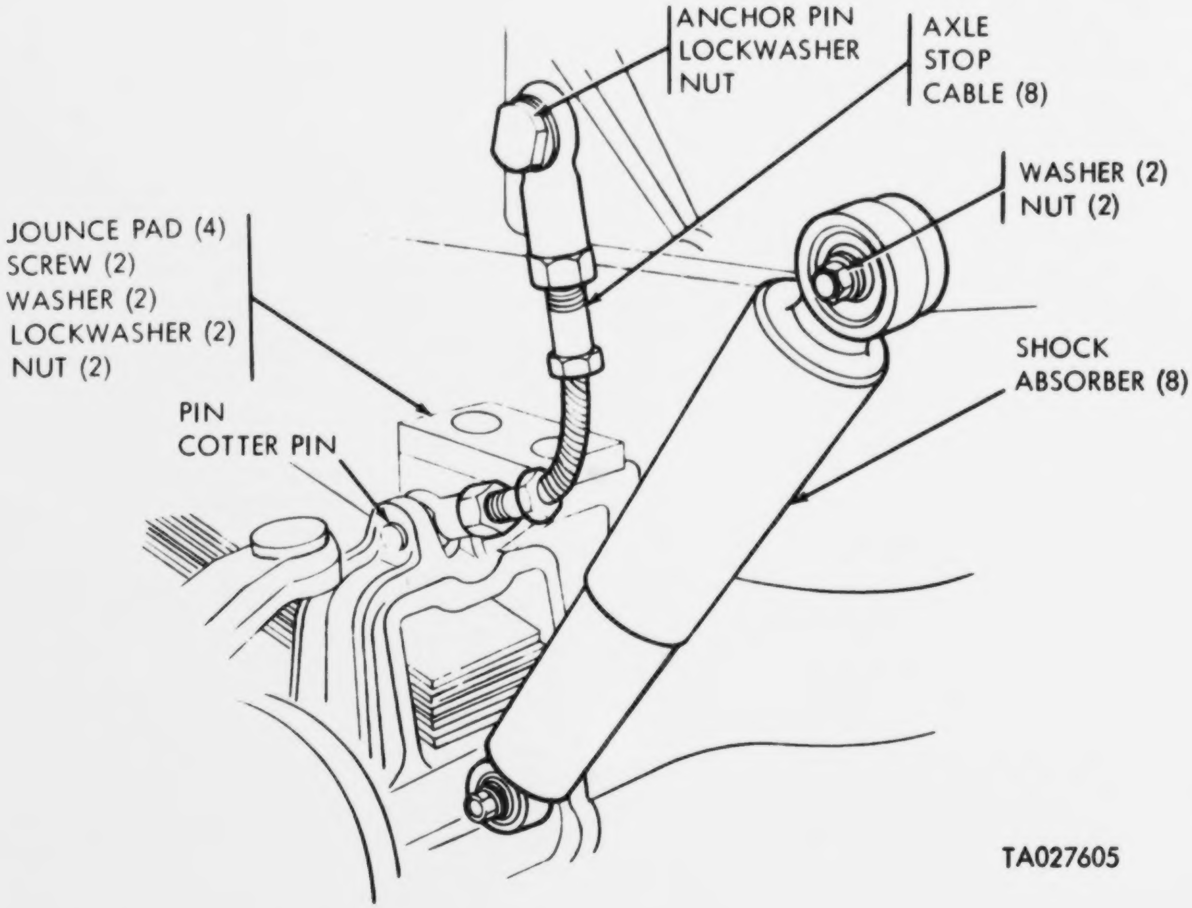

ANCHOR PIN
LOCKWASHER
NUT
AXLE STOP CABLE (8)
WASHER (2)
NUT (2)
JOUNCE PAD (4)
SCREW (2)
WASHER (2)
LOCKWASHER (2)
NUT (2)
PIN
COTTER PIN
SHOCK ABSORBER (8)
TA027605

Figure 2-167. Removal or installation of shock absorber, axle stop cable, and jounce pad.

Section XIX. REAR AXLES

2-113. Servicing Rear Axles

a. General. Servicing the rear axles consists of replacing damaged or worn spindle wipers or axle seals. These parts are inspected during service of rear hub and drum assembly. Refer to paragraph 2-131. Draining and filling rear axles with lubricant is done through drain and fill plugs similar to those on front axles (fig. 2-162).

b. Carrier Lube Pump.

(1) *Removal.* Drain oil from carrier. Disconnect tube assembly from pump. Remove four screws and lockwashers and remove pump and gasket. Remove fittings from pump. Refer to figure 2-168 and replace tube assembly, fittings, hose, or clamps as required.

(2) *Installation.* Install fittings on pump. Position pump and gasket and secure by installing four screws and lockwashers. Connect tube assembly on pump. Fill carrier assembly with oil prescribed in lubrication chart.

c. Shock Absorbers, Axle Stop Cables, and Jounce Pads. Refer to paragraph 2-112.

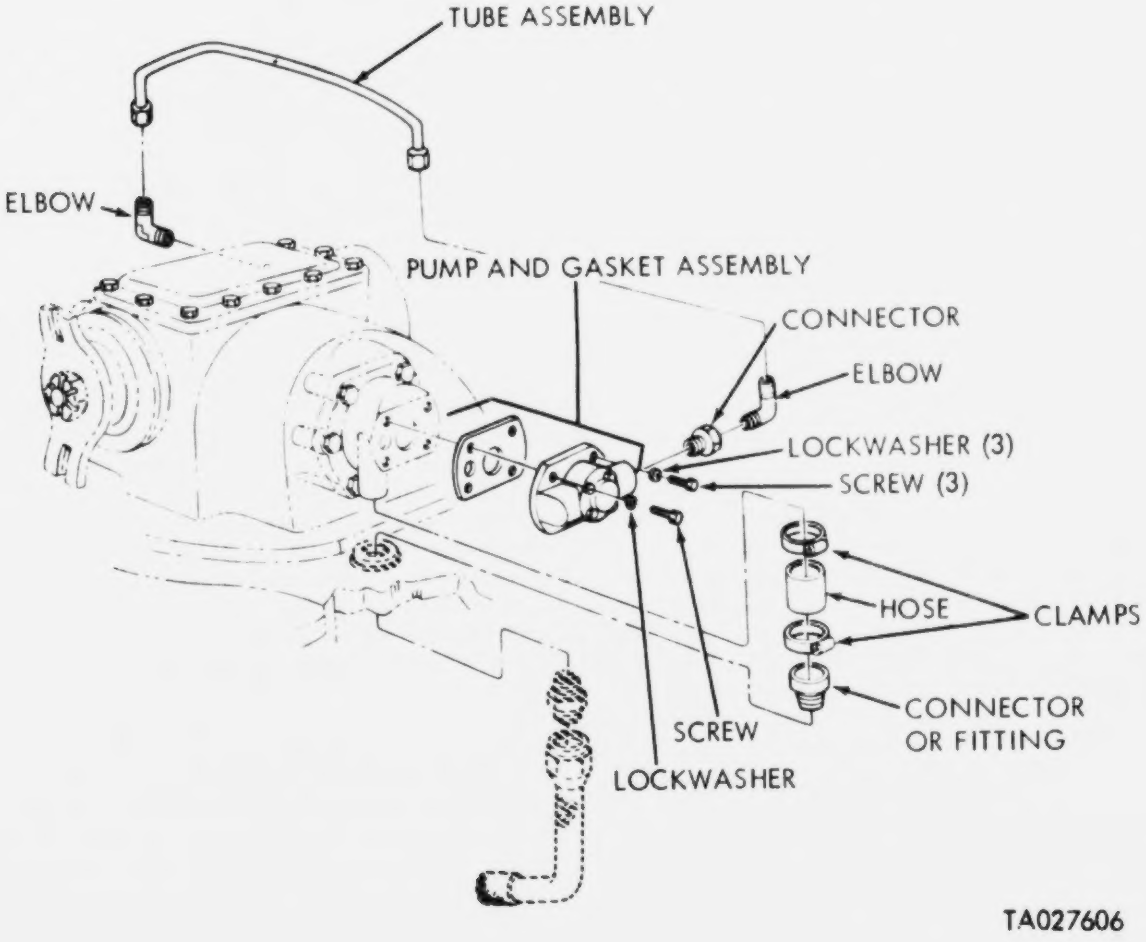
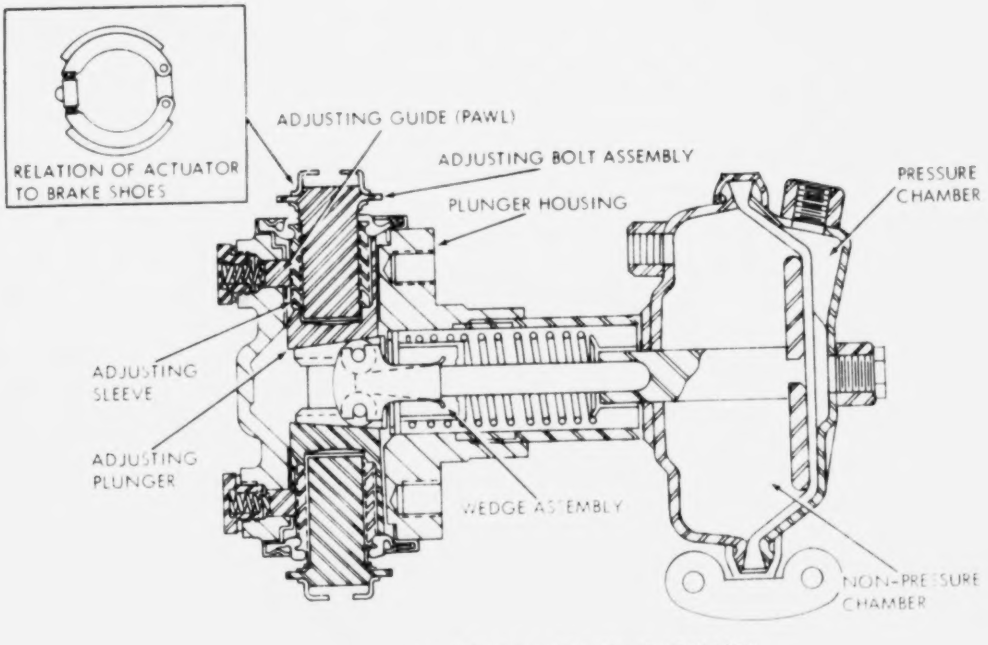

TUBE ASSEMBLY
ELBOW
PUMP AND GASKET ASSEMBLY
CONNECTOR
ELBOW
LOCKWASHER (3)
SCREW (3)
HOSE
CLAMPS
CONNECTOR OR FITTING
SCREW
LOCKWASHER
TA027606

Figure 2-168. Rear tandem axle oil pump and associated parts (typical).

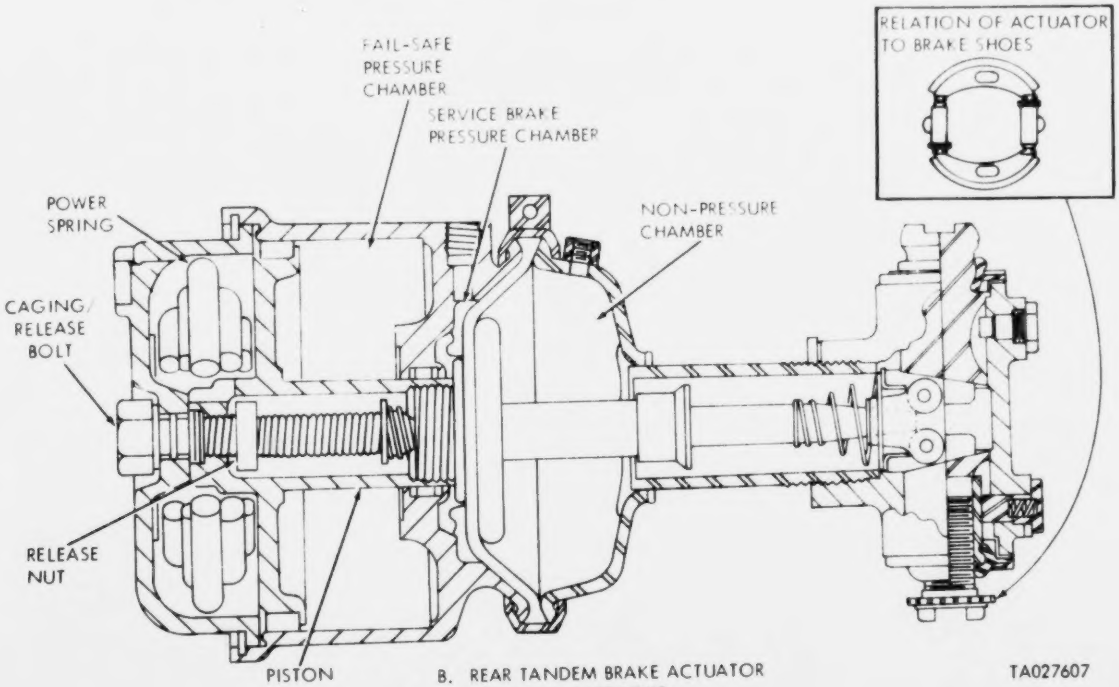
Section XX. BRAKES

2-114. Description and Data

a. Service Brakes. The air-operated brakes on the tractor are self-adjusting, internal-expanding and of the wedge-type design (A, fig. 2-169). The front tandem brakes use a single actuator on one end of the brake shoes and fixed hinge pins on the other end of the brake shoes. The rear tandem brakes use an actuator on either end of the brake shoes. The cab brake pedal is integral with the treadle air valve (16, fig. 2-170). Pressurized reservoir air is supplied to the treadle valve by an air line. Depressing

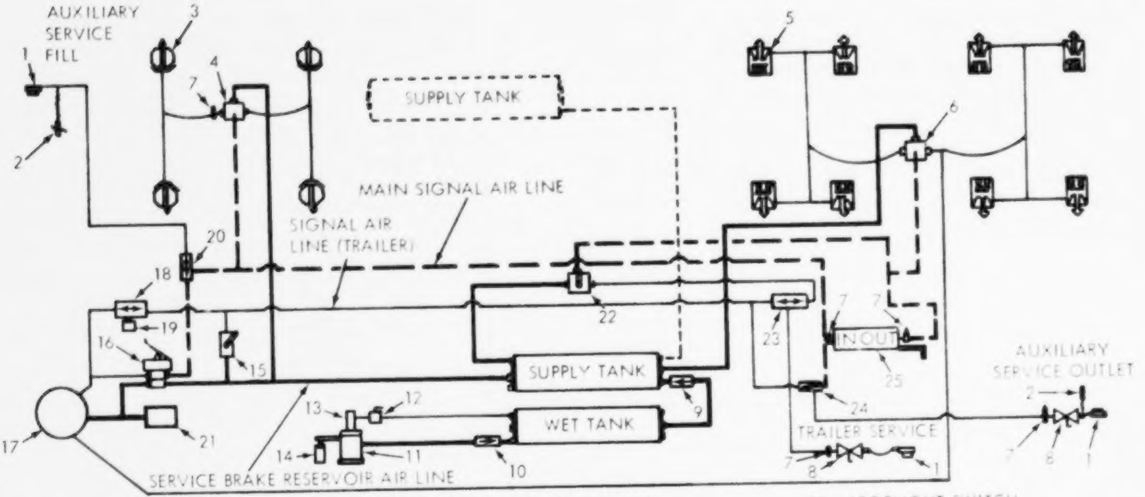

RELATION OF ACTUATOR TO BRAKE SHOES
ADJUSTING GUIDE (PAWL)
ADJUSTING BOLT ASSEMBLY
PLUNGER HOUSING
PRESSURE CHAMBER
ADJUSTING SLEEVE
ADJUSTING PLUNGER
WEDGE ASSEMBLY
NON-PRESSURE CHAMBER

A. FRONT TANDEM BRAKE ACTUATOR


FAIL-SAFE PRESSURE CHAMBER
SERVICE BRAKE PRESSURE CHAMBER
RELATION OF ACTUATOR TO BRAKE SHOES
POWER SPRING
NON-PRESSURE CHAMBER
CAGING/ RELEASE BOLT
RELEASE NUT
PISTON
TA027607

B. REAR TANDEM BRAKE ACTUATOR WITH FAIL-SAFE UNIT

Figure 2-169. Brakes cross section – front and rear tandem.



1. COUPLING
2. DUMMY COUPLING
3. SERVICE BRAKES (FRONT)
4. SERVICE RELAY VALVE (FRONT)
5. SERVICE PORTION OF REAR BRAKES
6. SERVICE RELAY VALVE (LEFT REAR)
7. DIAGNOSTIC VALVE
8. SHUT-OFF VALVE (MANUAL)
9. ONE-WAY CHECK VALVE
10. ONE-WAY CHECK VALVE
11. AIR-COMPRESSOR
12. SHUT-OFF COCK
13. GOVERNOR
14. ALCOHOL EVAPORATOR
15. TRAILER BRAKE HAND CONTROL VALVE
16. TREADLE VALVE
17. 3-WAY GAGE
18. TWO-WAY CHECK VALVE NO. 4
19. STOPLIGHT SWITCH
20. TWO-WAY CHECK VALVE NO. 1
21. SAFETY VALVE
22. TRAILER SERVICE AIR RELAY VALVE
23. TWO-WAY CHECK VALVE NO. 3
24. TWO-WAY CHECK VALVE NO. 2
25. BRAKE PROPORTIONING VALVE

TA027608

Figure 2-170. Service brake air system schematic.

the pedal sends a pressure signal, proportioned to the degree of pedal depression, through the main signal air line to the front and rear service relay valves (4 and 6, fig. 2-170). The relay valves then operate automatically to route a proportioned amount of pressurized reservoir air to the brake air chambers. The movement of the air chamber diaphragm causes the wedge in each actuator assembly to move forward, expanding the plungers, and pressing the brake shoes against the drum. The brake response is instantaneous and simultaneous at each wheel. When the brake pedal is released, the pressure signal ceases and the relay valves vent air pressure, releasing the brakes.

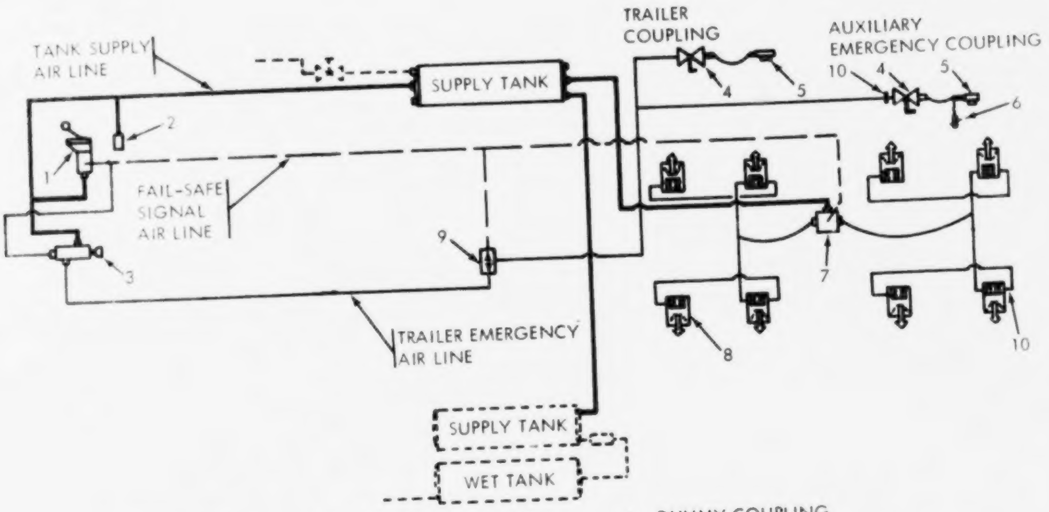
b. Fail-Safe Brakes. The fail-safe units (B, fig. 2-169) are spring-powered brake actuating units mounted piggyback on the air chamber of each rear brake. When approximately 65 psi or more air pressure is applied against the piston in the fail-safe head pressure chamber, the spring is held in a compressed position. When the air pressure is removed, the spring pushes the piston against the diaphragm plate and applies the brakes. Two fail-safe units are located on each rear tandem wheel. The fail-safes are supplied with spring holdoff air pressure through the right real relay valve (7, fig. 2-171). Pressurized air from the right supply tank is available at the reservoir port of the relay valve. Supply tank air also reaches the parking/emergency control valve (1, fig. 2-171) through the supply tank air line. During normal operation, the parking/emergency control is open and pressurized air passes directly to the fail-safe signal air line and to the signal port of the fail-safe relay valve. Air pressure at the signal port of the relay valve causes an influx of reservoir air to be maintained in the air lines to the fail-safe units, thus holding off the power springs. If the power springs cannot be compressed by air pressure, they may be caged (compressed) manually by turning the caging/release bolt, (B, fig. 2-169) approximately 25 full turns clockwise. Uncaging (releasing) the spring is accomplished by reversing the procedure. In any case, the caging/release bolt is not to be forced beyond its normal stop in either the clockwise or counterclockwise directions.

c. Tabulated Data. Refer to paragraph 1-7.

2-115. Brake Adjustment

a. General. The truck tractor brakes are automatically adjusted. The adjusting guide (pawl) (A. fig. 2-169), with directional teeth, allows the plunger mechanism to advance when the brakes are applied, but prevents the plunger mechanism from retracting to its bottomed position when the brakes are released. The adjusting bolt should be set, after servicing brakes, to give an 0.040 to 0.060 inch drum to lining clearance.

b. Checking brake to lining clearance after brake servicing.


TANK SUPPLY AIR LINE
SUPPLY TANK
TRAILER COUPLING
AUXILIARY EMERGENCY COUPLING
FAIL-SAFE SIGNAL AIR LINE
TRAILER EMERGENCY AIR LINE
SUPPLY TANK
WET TANK
1
2
3
4
5
6
7
8
9
10

1. PARKING/EMERGENCY BRAKE CONTROL VALVE
2. LOW PRESSURE SWITCH
3. TRAILER EMERGENCY FILL VALVE
4. SHUT-OFF VALVE
5. COUPLING
6. DUMMY COUPLING
7. RELAY VALVE, RIGHT REAR
8. FAIL-SAFE BRAKE UNIT
9. TWO-WAY CHECK VALVE NO. 5
10. DIAGNOSTIC TANK VALVE

TA027609

Figure 2-171. Fail-safe brake air system schematic.

(1) Compress fail-safe unit (para 2-116) if fail-safe brakes are not held off by air pressure.

(2) Check drum to lining clearance using feeler gage. If clearance is greater than 0.040 to 0.060 inch limits, brakes should be adjusted manually.

c. Adjustment of Brakes After Servicing.

NOTE

Brakes are self-adjusting and no manual adjustment is required except after brake servicing.

(1) Jack or hoist wheels free of ground.

(2) Compress fail-safe unit (para 2-116) unless held off by air pressure.

(3) Insert long screwdriver into a slot of adjusting bolt head. Turn right threaded adjusting bolt until a heavy drum drag occurs when turning wheel. If adjusting bolt will not turn using hand pressure, tap adjusting tool with hammer.

NOTE

If adjusting bolts are not found below the forward and above the rear actuator on the rear wheels, the brake has been assembled on the wrong side of the vehicle.

(4) Back off the adjusting bolt until 0.040 to 0.060 inch clearance is obtained.

(5) Repeat procedure for other shoe on brake.

2-116. Manually Releasing and Applying Fail-Safe Brakes

When parking brake control is applied and/or air pressure falls below 65 psi, spring in fail-safe unit forces brakes to apply. To back-off (cage) spring and release brakes for servicing, turn bolt approximately 25 full turns clockwise as shown in figure 2-172.

CAUTION

Do not force bolt beyond its normal stop in either direction as release bolt threads may be stripped.

After servicing, reapply brakes by turning bolt approximately 25 full turns counterclockwise. Manually releasing and applying fail-safe brakes is made easier by applying air pressure to fail-safe chamber to take spring-load off release bolt.

CAUTION

Before removal of hub and drum assembly with air pressure below 65 psi or before servicing air chambers, release fail-safe brakes. After servicing and before returning vehicle to service, apply fail-safe brakes by turning caging/release bolt approximately 25 full turns counterclockwise.

2-117. Testing Air Chamber for Leaks

With air hose couplings connected to towing vehicle and brakes applied, coat brake air chamber housing flanges and connections with soapy water to check for leakage. No leakage is permissable. If leakage is found at flanges, tighten air chamber clamp ring bolt(s). If leakage is found at fitting, tighten fitting.

NOTE

When attempting to replace the brake actuator seal (2530-00-015-7565) on axles 1 and 2, it may be noted that the bolt adjustor (A2-2297-D2370) may or may not have a snapring (1779Z650) located inside the actuator (227F2372). This can be determined by turning adjusting bolt counter clockwise. If bolt can be removed, snapring is not included in the assembly, however, if the adjusting bolts lock at end of actuator, adjustment, then snapring is in position on adjusting bolt. To remove adjusting bolt, snapring must be removed by using a flat tip screw driver found in common tool kit. When removed, proceed with procedures as described in paragraph 2-118.

2-118. Scheduled Brake Maintenance

Scheduled brake maintenance entails disassembly and assembly of brakes at each wheel for the purpose of the following services:

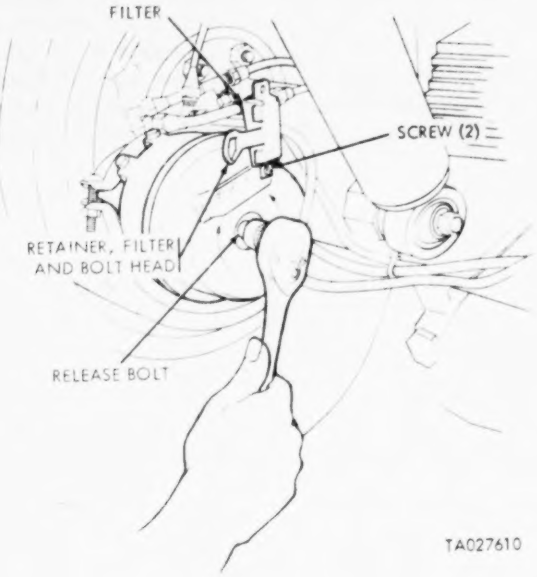


Figure 2-172. Manually releasing fail-safe brakes.

(1) Inspect brake lining thickness; replace if determined lining will not last until next scheduled maintenance (front brakes, para 2-119*a*) (rear brakes, para 2-120*a*).

(2) Clean, inspect and lubricate brake plungers (front brakes, para 2-119*e*), (rear brakes, para 2-120*e*).

(3) Replace plunger seals if required (front brakes, para 2-119*e*), (rear brakes, para 2-120*e*).

(4) Inspect air chambers (front brakes, para 2-119*c*), (rear brakes, para 2-120*c*), and disassemble and clean, if required.

(5) Generally, inspect all brake assemblies for damaged or missing parts and replace as required.

(6) After brakes have been disassembled, see para 2-108 for servicing CV joint and trunnion socket.

2-119. Servicing Front Tandem Brakes

NOTE

The following servicing procedures, unless otherwise indicated, are performed after wheel (para 2-129) and hub assembly (para 2-130) have been removed and after air system has been drained.

a. Brake Shoes Replacement. Replace brake shoes (4 and 5, fig. 2-173) if lining is damaged or worn to within 1/32-inch of rivet heads. Approximately 1/4-inch of stock is above rivet heads on new brake lining. By recording lining wear between scheduled annual brake maintenance periods, expected wear can be calculated. Lining that will not last until next scheduled maintenance interval should be replaced. Replace if shoe is badly scored, cracked or distorted. Replace shoe if fit on anchor pin is loose. Brake shoes are replaced as follows:

(1) Remove shoe return spring (1, fig. 2-173) using special tool pliers as shown in figure 2-174.

(2) Remove two lockrings (2, fig. 2-173) and strap (3) from anchor pins (8). Slide each brake shoe (4 and 5) off of anchor pin. If hub remains on axle, slide brake shoes between bosses on hub rear and then pivot shoes free.

(3) Inspect spacers (6) and anchor pins (8) for damage. If necessary for replacement, slide spacers (6) of anchor pins (8), remove setscrews (7) from steering knuckle and remove anchor pins. Position replacement anchor pins (8) in steering knuckle and retain by installing setscrews (7). Place spacers (6) over anchor pins.

(4) Unless brake plungers (A, fig. 2-169) are to be serviced (*e* below), install brake shoes after applying GAA grease conservatively to shoe rest pads, anchor pins, and slots in adjusting bolt heads. Upper brake shoe (4, fig. 2-173) is not interchangeable with lower brake shoe (5). Secure shoes with strap (3) and two lockrings (2). Aline slots in adjusting bolt assemblies (A, fig. 2-169) with shoe rest pads and install return spring as shown in figure 2-174.

b. Removal and Installation of Air Chamber (fig. 2-173).

NOTE

Wheel need not be removed to replace air chamber.

(1) Drain air system and disconnect air lines to air chamber.

(2) Use drift and hammer to loosen collet nut (9); then unscrew air chamber assembly (10) from actuator housing assembly (11).

(3) Wedge assembly (14) may be removed and inspected at this point (*d* below).

(4) To install air chamber assembly (10), make certain that wedge assembly (14) is properly seated (*d* below). Install collet nut (9) on new air chamber assembly. Screw air chamber assembly (10) into actuator housing assembly (11) until air chamber bottoms (collet nut loose). Aline connection port with air line. If required, unscrew air chamber not more than one full turn. Connect air line.

(5) If possible, make and hold a full-pressure brake application. Hand tighten collet nut (9), then drive collet nut 1-1/2 teeth (or 3/16 turn) with drift and hammer. Release and reapply pressure and check for leaks.

c. Disassembly, Service and Assembly of Air Chamber (fig. 2-175).

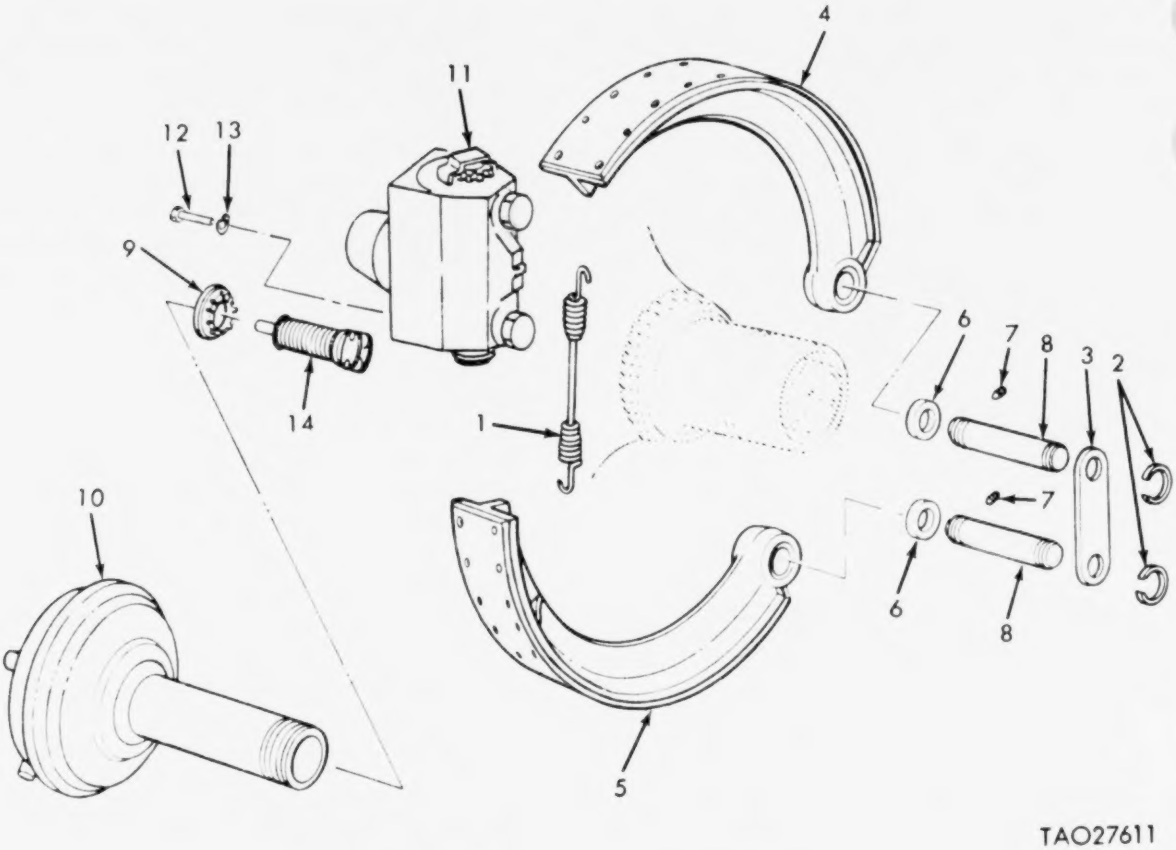
NOTE

Wheel need not be removed to service air chamber on vehicle.

(1) Drain air system and disconnect air lines.

NOTE

Although following sequence is oriented to scheduled maintenance, when air chamber remains on vehicle, it should be referred to for any repair to the air chamber assembly.



1 Spring, shoe return
2 Ring, lock (2)
3 Strap
4 Brake shoe, upper
5 Brake shoe, lower
6 Spacer (2)
7 Setscrew (2)
8 Pin, anchor (2)
9 Nut, collet
10 Chamber assembly, air
11 Housing assembly, actuator
12 Screw (2)
13 Lockwasher (2)
14 Wedge assembly

Figure 2-173. Front axle brake assembly — exploded view.

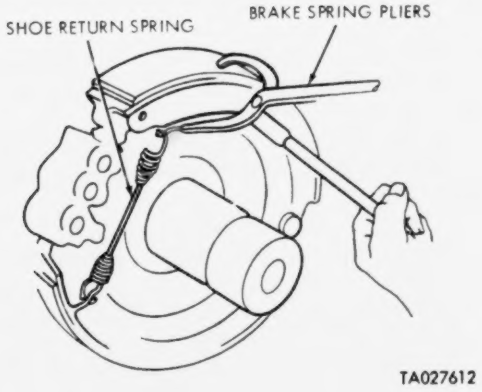


Figure 2-174. Removal or installation of brake shoe return spring.

(2) Remove ring clamp nuts (fig. 2-175) and bolts. Remove ring clamp. Hold the diaphragm on the non-pressure half and remove air pressure housing. Carefully remove the diaphragm while holding diaphragm plate against the wedge assembly (14, fig. 2-173). This prevents wedge assembly from coming out of engagement with plungers.

NOTE

> If wedge assembly backs out of plunger any time during this procedure, or if evidence of dirt appears, remove non-pressure housing from brake for cleaning and to facilitate proper re-engagement of wedge assembly (*d* below).

(3) Inspect guide (fig. 2-175) for wear and replace if necessary. Thoroughly clean diaphragm plate assembly using wire brush. Clean diaphragm using soap and

water. Replace diaphragm if cracked or torn or if diaphragm edge is distorted by indentation. If necessary, remove non-pressure housing and clean.

(4) Press wedge guide all the way onto end of pushrod. Position diaphragm plate pushrod into tube. Carefully engage wedge rod to prevent it pulling out of plungers. While holding diaphragm plate against wedge, install new diaphragm over plate and onto non-pressure housing while pushing plate against wedge. Assemble pressure-half and ring clamp. Secure using two nuts and bolts.

(5) Make a full pressure brake application at the earliest opportunity and check for leaks.

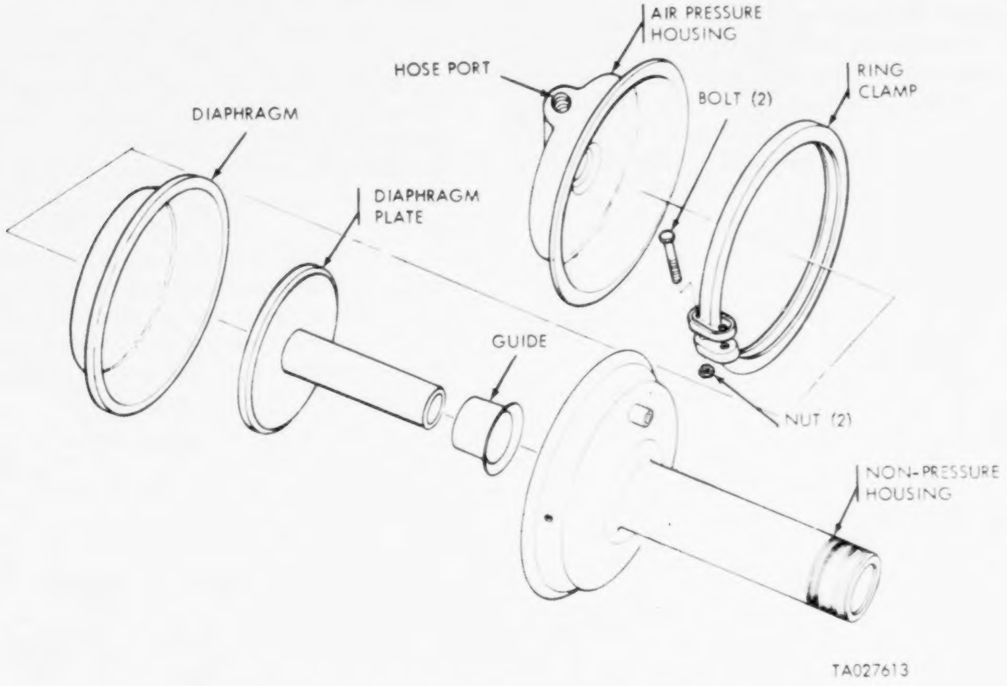


Figure 2-175. Front axle brake air chamber — exploded view.

d. Replacement of Wedge Assembly.

NOTE

Wheels need not be removed to replace wedge assembly.

(1) *Removal.* Remove wedge assembly (14, fig. 2-173) while air chamber assembly (10) is detached from plunger housing (*b* above). Pull wedge assembly straight out of housing.

(2) *Inspection of wedge assembly.* Clean wedge assembly thoroughly. If necessary, replace assembly. Without disturbing position of plungers, wipe out plunger housing wedge bore with rag.

(3) *Installation of wedge assembly into plunger.* Check for proper engagement. Be sure rollers on wedge assembly meet plungers in plunger housing; push on wedge rod by hand, while checking for plunger and shoe lift (drag felt on wheel if wheel remains on axle) and measure standout of the wedge rod from end face of plunger housing (fig. 2-176). When properly assembled, the wedge standout is 2-¼ inches.

e. Servicing Brake Plunger Parts. The following procedures apply when wheel, drum, and shoe return spring have been removed.

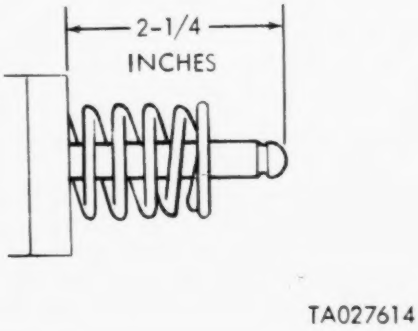


Figure 2-176. Correct wedge standout from plunger housing.

(1) *Removal and disassembly* (fig. 2-177)

(*a*) Remove two adjusting guide assemblies and special lockwashers from housing side bosses.

(*b*) Carefully pry lips of seal assemblies loose from plunger housing. Remove adjusting sleeve, bolt, and seal assemblies, along with adjusting plungers from top and bottom of plunger housing. Separate removed parts.

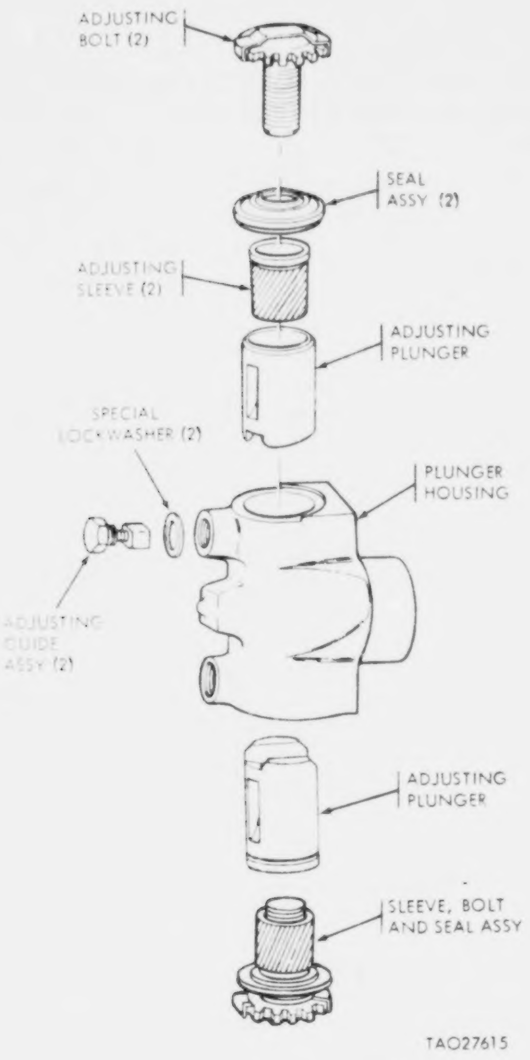


Figure 2-177. Front axle plunger housing assembly — exploded view.

(2) *Cleaning and inspection.* Thoroughly clean and inspect all parts, including the housing plunger and seal bores. Do not use solvent to clean seal assemblies. Wire brush plunger parts and adjusting bolt threads to remove caked-on dirt and corrosion. Carefully inspect plunger seal assemblies for tears, cuts or deterioration. Replace if necessary. Also check the angled plunger roller faces for pits, grooves or nicks. Replace if necessary. A bright, shiny surface where wedge roller contacts surface is normal.

(3) *Assembly and installation.*

(*a*) Grease coat inside and outside surfaces of adjusting plunger (see LO 9-2320-258-12). Grease coat plunger bores in plunger housing. Insert adjusting plunger into plunger housing so that plunger keyway slot is alined with guide hole. Lightly coat adjusting guide assembly (with directional teeth) with grease and install adjusting guide assembly with special lockwasher. Adjusting guide assembly is keyed so it will fit in plunger housing bore in only one way. If misfit is felt, remove adjusting guide assembly and reinstall in reverse position. Turn capscrew of adjusting guide assembly one or two turns in.

(*b*) Grease coat adjusting sleeve inside and out and carefully position seal on sleeve. Pack cavity under seal with grease. Lower lip of seal will seat in groove of sleeve. Insert the sleeve into adjusting plunger so adjusting guide and sleeve teeth mesh. If necessary, back off capscrew to enable meshing of guide and sleeve teeth. Push adjusting sleeve into plunger until it bottoms.

(*c*) Grease coat plunger seal lip lightly and seat seal into plunger using 1-$^{13}/_{16}$ socket from your common tool set. Place socket over plunger seal and gently tap socket into proper position with plastic hammer. Socket must be centered over seal assembly retainer to prevent damage to seal assembly.

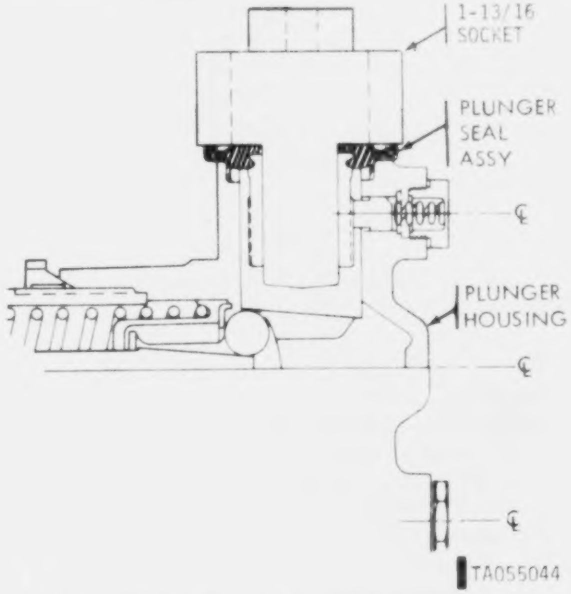


Figure 2-178. Installing seal assembly in front axle brakes plunger housing.

(*d*) Grease coat entire head of adjusting bolt (fig. 2-177) and coat threads. Thread adjusting bolt through seal into adjusting sleeve carefully so as not to damage seal, until bolt bottoms. Do not bottom on seal. Proper meshing of guide and sleeve teeth can be checked at this point. A clicking sound and a ratcheting feel will indicate meshing of teeth. This may occur while threading adjusting bolt in (incline on sleeve teeth slides off incline on guide teeth). Unscrew the adjusting bolt three turns; no clicking sound or ratcheting feel should occur.

(*e*) Tighten adjusting guide capscrew to 15-20 lb.-ft. torque.

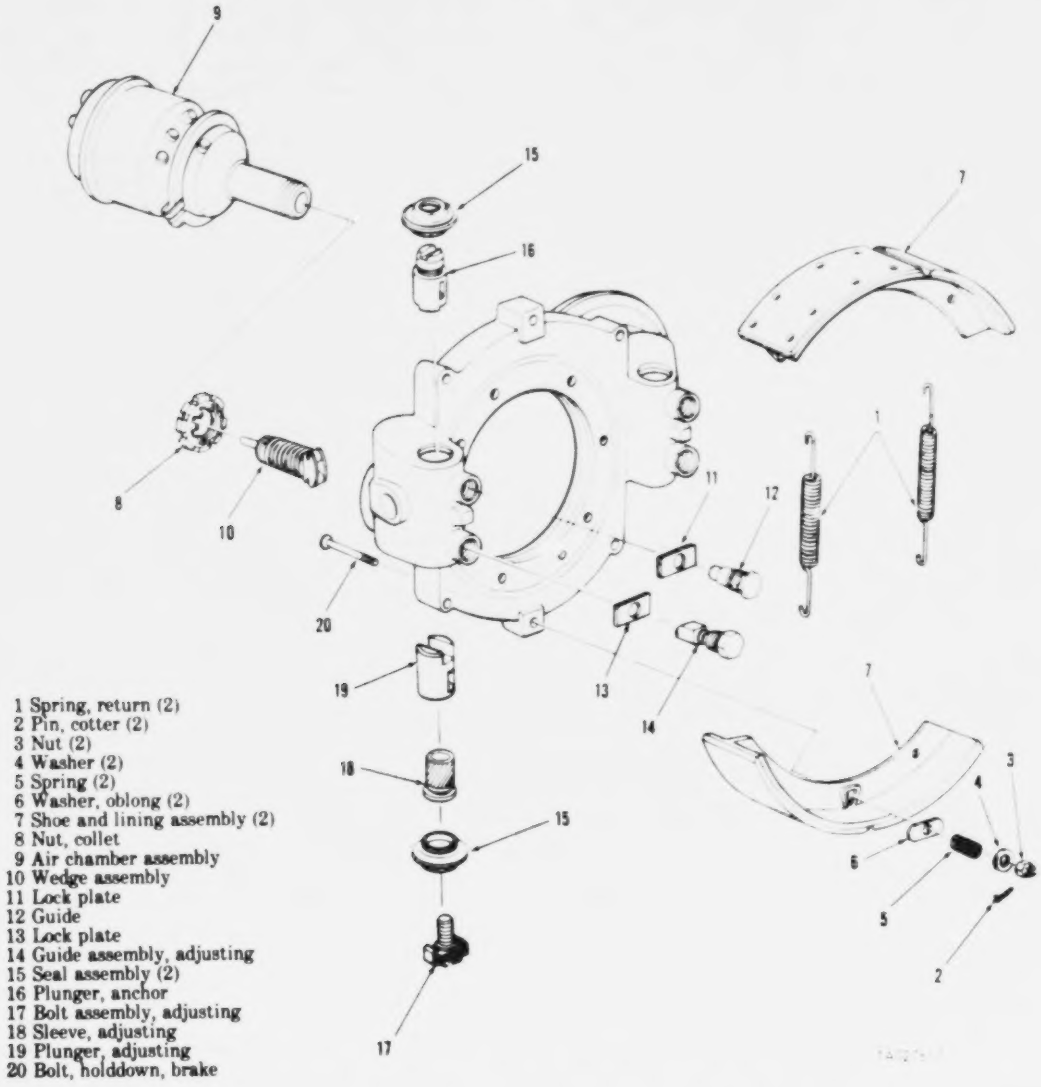
(*f*) Turn adjusting bolt into just short of seal. Do not bottom it on seal. Pull bolt and sleeve outward slightly against seal to assure entry of seal lip in sleeve groove. Push bolt and sleeve back into plunger.

(*g*) Repeat procedure (*a*) through (*f*) above for remaining adjusting plunger assembly.

(*h*) After servicing brake plungers, install brake components and hub and drum assembly on axle, and check lining clearance. Adjust brake lining to drum clearance for 0.040 to 0.060 inch, as described in paragraph 2-115*c*.

2-120. Servicing Rear Tandem Brakes

a. Replacement of Rear Brake Shoes. Shoe and lining assembly (7, fig. 2-179), identified in this procedure as brake shoe, is to be replaced if lining is worn to within 1/32-inch of rivet heads. On new lining on axles 3 and 4, approximately 1/2-inch of stock is above center rivet heads and 3/8-inch stock is above end of rivet heads. By recording lining wear between scheduled annual brake maintenance, expected wear can be calculated. Lining that will not last until next annual maintenance requires replacement of shoe and lining assembly. Next higher maintenance level will replace lining on removed assembly. Shoe and lining assemblies are replaced as follows:



1 Spring, return (2)
2 Pin, cotter (2)
3 Nut (2)
4 Washer (2)
5 Spring (2)
6 Washer, oblong (2)
7 Shoe and lining assembly (2)
8 Nut, collet
9 Air chamber assembly
10 Wedge assembly
11 Lock plate
12 Guide
13 Lock plate
14 Guide assembly, adjusting
15 Seal assembly (2)
16 Plunger, anchor
17 Bolt assembly, adjusting
18 Sleeve, adjusting
19 Plunger, adjusting
20 Bolt, holddown, brake

Figure 2-179. Rear brake assembly — exploded view.

(1) Remove hub and drum (para 2-131).

(2) Remove return springs (1, fig. 2-179) using suitable brake spring pliers as shown in figure 2-174.

(3) Remove cotter pin (2, fig. 2-179), nut (3), washer (4), spring (5), and oblong washer (6) from each shoe web. Remove shoe and lining assemblies (7).

(4) To install shoes, position shoes so that web rests correctly in plunger slots. Install oblong washers, spring, washer, nut, and cotter pin to retain each shoe.

NOTE

Do not install shoes backwards. Long radius of shoe web should be in the adjusting bolt slot (fig. 2-180). Adjusting bolt should be at upper right and lower left on left side wheel, and at upper left and lower right on right side wheel.

Use brake spring pliers to install return springs.

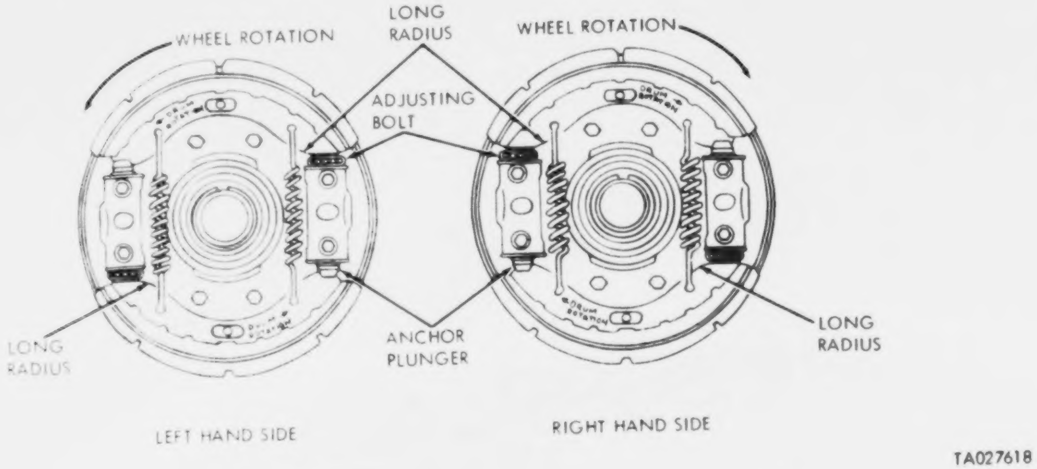

WHEEL ROTATION
LONG RADIUS
WHEEL ROTATION
ADJUSTING BOLT
LONG RADIUS
ANCHOR PLUNGER
LONG RADIUS
LEFT HAND SIDE
RIGHT HAND SIDE
TA027618

Figure 2-180. Plunger and shoe position for left side and right side rear brakes.

b. Replacement of Fail-Safe Unit. The fail-safe housing serves as upper half of each of rear brake air chambers (B, fig. 2-169). Fail-safe unit may be replaced by itself (1) and (2) below), or whole fail-safe air chamber assembly may be replaced ((3) and (4) below).

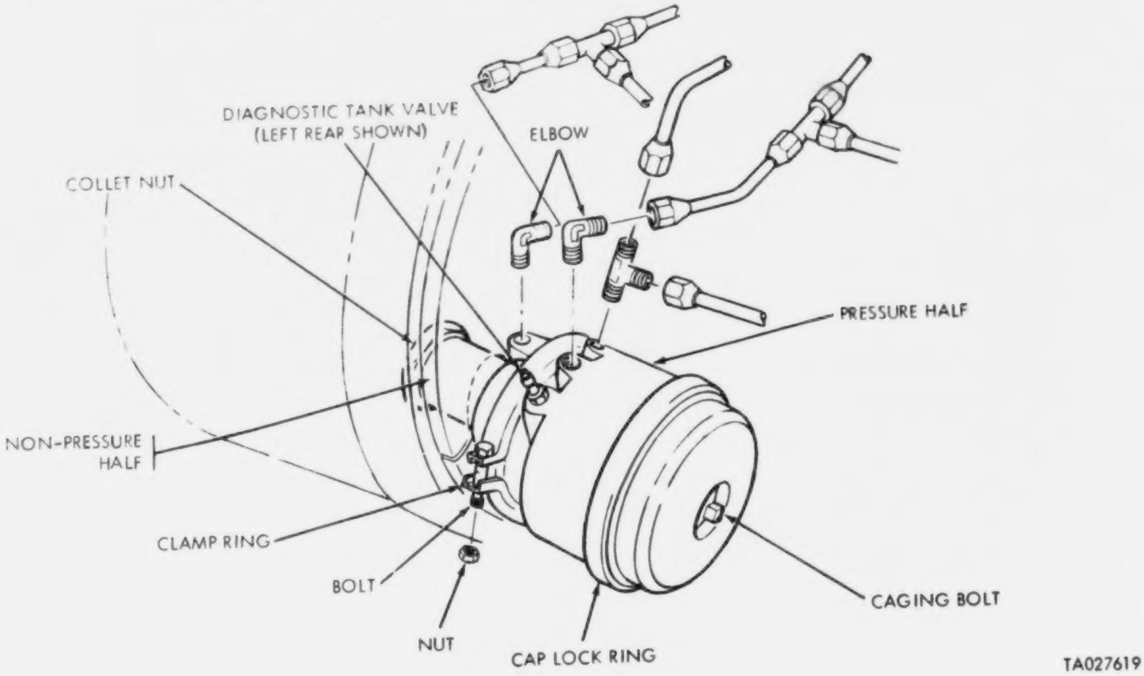

DIAGNOSTIC TANK VALVE (LEFT REAR SHOWN)
COLLET NUT
ELBOW
PRESSURE HALF
NON-PRESSURE HALF
CLAMP RING
BOLT
NUT
CAP LOCK RING
CAGING BOLT
TA027619

Figure 2-181. Removal or installation of fail-safe assembly.

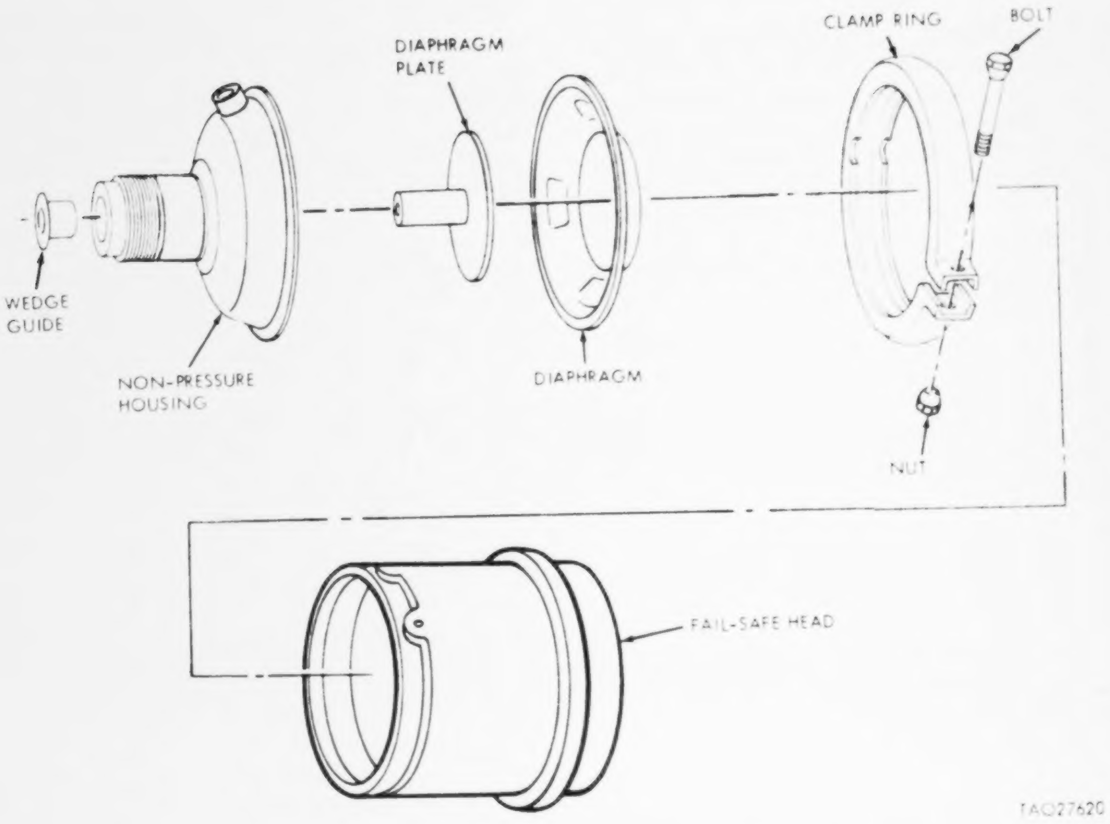


Figure 2-182. Rear brake air chamber assembly — partially exploded view.

WARNING

To avoid possible injury, manually compress (cage) fail-safe power spring (para 2-116) before attempting any removal or disassembly of fail-safe unit.

(1) *Removal of fail-safe head.* Manually compress (cage) fail-safe power spring (para 2-116). Remove air lines from pressure half ports (fig. 2-181). Loosen nut on bolt securing clamp ring. Hold diaphragm (fig. 2-182) on non-pressure housing and remove fail-safe head. The diaphragm should be replaced if rubber at sealing area is damaged or has taken a set.

(2) *Installation of fail-safe head.* Position fail-safe head against non-pressure housing and tighten nut on clamp ring bolt. Clamp ring is to be positioned so opening retained by bolt and nut is 45° toward rear of vehicle from twelve o'clock position for fail-safe at rear of wheel (fig. 2-181) and 45° toward front of vehicle for fail-safe at front wheel position. Torque nut to 15-20 lb.-ft.

(3) *Removal of fail-safe air chamber assembly.* Manually compress power spring (para 2-116). Disconnect and tag air lines. Use drift and hammer to loosen collet nut (8, fig. 2-179). Unscrew air chamber assembly (9) from plunger housing. Wedge assembly (10) may be removed and inspected at this point (*d* below).

(4) *Installation of fail-safe air chamber assembly.* Check position of wedge (10) in plunger housing to make certain wedge assembly is properly seated (*d* (3) below). Install collet nut (8) on air chamber stem. Screw fail-safe air chamber assembly (9) into plunger housing until it bottoms (collet nut loose). Aline connection ports with air lines. If required, unscrew fail-safe air chamber assembly (9) not more than one full turn. Refer to step (2) above for proper position of ring clamp (fig. 2-181). Connect air lines. If possible, make and hold a full-pressure service brake application and hand tighten collet nut. Check for leaks at connections. Release service brake pressure. If wheel, hub, and drum are installed, release fail-safe power spring.

c. Cleaning and Repairing Air Chamber Assembly. The following procedures are used to replace the diaphragm (fig. 2-182) while the non-pressure housing remains on the vehicle.

(1) *Disassembly.*

(*a*) Remove fail-safe head (*b* (1) above), holding the diaphragm (fig. 2-182) on the non-pressure housing in place.

(*b*) Carefully remove the diaphragm, while holding diaphragm plate against the wedge assembly (10, fig. 2-179). This will prevent the wedge assembly from coming out of engagement with the plungers.

NOTE

If wedge assembly backs out of plunger any time during this procedure, or if evidence of dirt appears, remove non-pressure housing from brake for cleaning and to facilitate proper re-engagement of wedge assembly (*d* below).

(*c*) Thoroughly clean diaphragm plate assembly, using wire brush. Clean diaphragm using soap and water. Replace diaphragm if cracked or torn, or if diaphragm edge is distorted by indentation. If necessary, remove non-pressure housing and clean.

(2) *Assembly.*

(*a*) Press wedge guide (fig. 2-182) all the way onto pushrod end of diaphragm plate and position in non-pressure housing.

(*b*) While holding diaphragm plate against wedge, install new diaphragm over plate, and onto non-pressure housing, while pushing plate against wedge. Install fail-safe head as outlined in *b* (2) above.

d. Replacement of Wedge Assembly.

(1) Remove wedge assembly (10, fig. 2-179) while air chamber is detached from plunger housing (*b* (1) above). Pull wedge assembly straight out of housing.

(2) Inspect wedge assembly for damaged or inoperable parts. Clean wedge assembly thoroughly. If necessary, replace assembly without distrubing position of plungers and wipe out plunger housing wedge chamber with rag.

(3) Install wedge assembly into the plunger housing. Check for correct roller-plunger engagement by:

(*a*) Observing that ears on wedge assembly are in corresponding slots in wedge bore;

(*b*) Pushing on wedge rod by hand, while checking for plunger and shoe lift, and

(*c*) Measuring the standout of the wedge rod from the end of the threaded plunger housing bore (fig. 2-176). When properly assembled, the wedge standout is 2¼ inches.

e. Servicing Plungers. The following procedures apply when wheel, drum and brake shoes have been removed from vehicle. Disassemble, service, and assemble one plunger housing assembly at a time to avoid improper installation. Proper positions of adjusting bolts and anchor plungers for right side and left side wheels are shown in figure 2-180.

(1) *Disassembly.* Bend lock plate (11, fig. 2-179) back from head of guide (12) and remove guide and lock plate from plunger housing boss. Guide screw is located on the upper left and lower right on left side wheels, and on lower left and upper right on right side wheels. Bend lock plate (13) back from head of adjusting guide assembly (14) and remove guide assembly and lock plate. Carefully pry plunger seals (15) loose and remove anchor (solid) plunger (16), adjusting bolt assembly (17), with adjusting sleeve (18) and adjusting plunger (19). Replace adjusting bolt assembly (17) if threads are damaged or shoe retainer slot is badly worn.

(2) *Inspection and servicing.* Thoroughly inspect and clean all parts, including housing plunger, seal bores, and shoe rest pads. Do not use solvent to clean any rubber parts (plunger seals or gaskets). Wire brush plunger parts and adjusting bolt threads to remove caked-on dirt and corrosion. Carefully inspect plunger seals and gaskets for tears, cuts or deterioration. Replace if necessary. Also check angled plunger roller faces for pits, grooves or nicks; and replace if necessary. A bright, shiny surface where wedge assembly roller contacts surface is normal.

(3) *Assembly.*

(*a*) Assemble seal (15, fig. 2-179) onto anchor plunger (16).

NOTE

Each plunger housing has one adjusting plunger and one anchor plunger. The anchor plunger is marked on the slotted end "R" for right-side brakes and "L" for left-side brakes. Do not mix at reassembly.

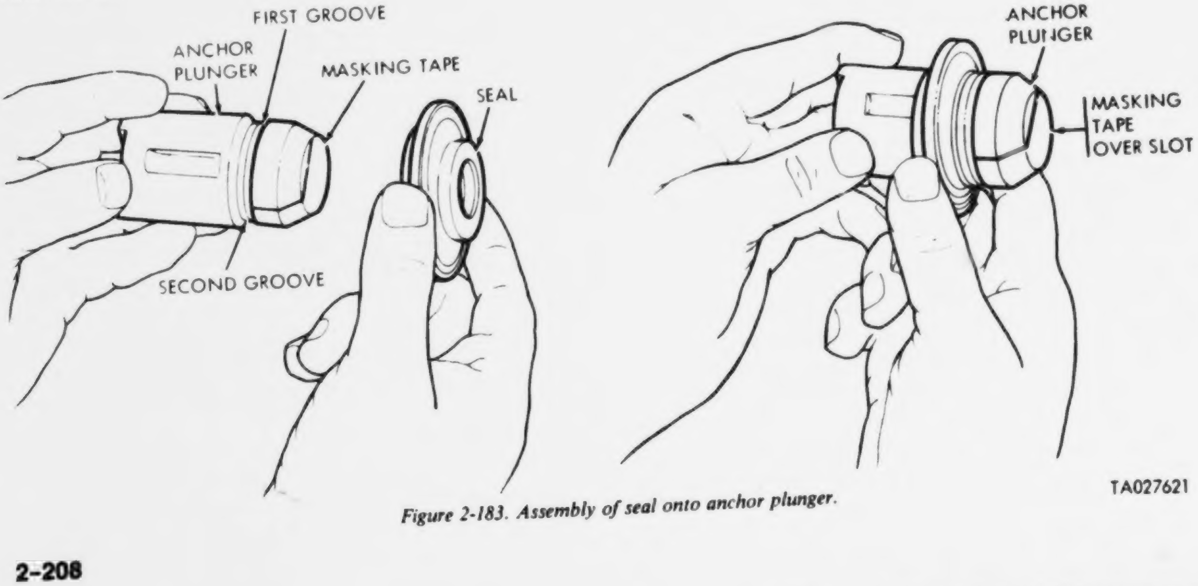


Figure 2-183. Assembly of seal onto anchor plunger.

1. Apply film of grease GAA (MIL-G-23827) to inside surfaces of seals.

2. On anchor plungers, inspect nose for burs. Mask brake shoe web slot in the plunger nose with masking tape to protect seal (fig. 2-183). Carefully, push double-lip seal onto plunger, stretching outer seal lip over plunger nose end, until inner seal is completely in second plunger groove and outer seal lip is in first plunger groove. Remove masking tape.

(*b*) *Installation of plunger assemblies.*

1. Coat all plunger bores with grease (see lubrication order, LO 9-2320-258-12).

2. Install anchor plunger marked "L" in left-hand brake and anchor plungers marked "R" in right-hand brake.

3. Coat entire anchor plunger (16, fig. 2-179) with grease, packing cavity behind seal, and insert plunger and seal into housing with plunger keyway slot alined with guide screw hole. The plunger must go all the way into plunger bore and seat on bosses at bottom.

4. Seat plunger seal (15) in plunger housing using 2-inch socket with ¾-inch drive from common tool set. Place socket over plunger seal and gently tap socket with plastic hammer.

5. Position lock plate (11) on guide screw (12) and install guide screw into plunger housing. Make certain guide screw end enters plunger keyway slot, so plunger can slide freely in housing bore. Tighten guide screw (12) to 15-20 lb.-ft. torque. Bend lock plate (11) over screw cap.

6. Grease-coat inside and outside surfaces of adjusting plunger (19). Place plunger (19) into plunger housing, alining plunger keyway slot with guide hole. Lightly coat adjusting guide assembly (14) with grease. Install adjusting guide assembly (14) with lock plate (13) into plunger housing. Adjusting guide assembly will fit into plunger housing bores in only one way. Turn adjusting guide screw one or two turns in.

7. Grease-coat adjusting sleeve (18) and carefully assemble plunger seal (15) onto adjusting sleeve (18) by installing seal lower lip in sleeve groove. Insert adjusting sleeve (18) into plunger (19), wiggling it, so adjusting guide and sleeve teeth mesh. If necessary, back adjusting guide assembly (14) off to enable meshing of guide and sleeved teeth. Push adjusting sleeve into plunger until it bottoms.

8. Using special tool driver for rear brakes, seat seal into plunger housing as in (4) above. Hand tighten adjusting guide assembly (14) into plunger housing.

9. Proper meshing of adjusting guide and sleeve teeth can be checked at this point. Grease-coat adjusting bolt (17) threads. Thread adjusting bolt into sleeve (18) after working it through seal flap hole, being careful not to pinch the seal in threads. Thread adjusting bolt into adjusting sleeve until it bottoms. Do not bottom adjusting bolt on seal. A clicking sound and a ratcheting feel will indicate meshing of teeth. This may occur while threading adjusting bolt in (incline on sleeve teeth slides off incline on guide teeth). Unscrew adjusting bolt three turns; no clicking sound or ratcheting feel should occur.

10. Tighten adjusting guide assembly (14) capscrew to 15-20 lb.-ft. torque.

11. Turn adjusting bolt (17) in until just short of seal. Do not bottom it on seal. Pull bolt and sleeve outward slightly against seal to assure entry of seal lip in sleeve groove. Push bolt and sleeve back into plunger.

12. After servicing brake plungers on both plunger housings at wheel, install brake components, hub and drum assembly and check lining clearance. Brake lining to drum clearance should be adjusted to 0.040 - 0.060 inch, as described in paragraph 2-115.

Section XXI. COMPRESSED AIR SYSTEM

2-121. Description and Data

a. General. The air system includes an air compressor, air lines, fittings, valves, controls, and reservoir tanks necessary to operate the brake and accessories air systems. The alcohol evaporator unit is provided to prevent freezing of moisture in the system. Normal system operating pressure is 90 to 120 psi.

b. Servicing Brake Air System (fig. 2-170). The cab brake pedal is integral with the treadle air valve (16) which is supplied reservoir air by an air line. Depressing the pedal sends an instantaneous pressure signal, proportioned to the degree of pedal depression, through the main signal air line to the front and rear service brake relay valves (4) and (6). The relay valves then automatically route a proportioned amount of pressurized reservoir air to the brake air chambers (3) and (5). The brake response is instantaneous and simultaneous at each wheel. When the brake pedal is released, the pressure signal ceases and the relay valves vent air pressure and release the brakes.

c. Brake Proportioning System (fig. 2-170). The brake proportioning system automatically adjusts rear braking to fit the load on the rear of the tractor. The brake proportioning valve (25) setting is controlled by linkage fixed to the rear axles and to the actuator lever on the valve which is frame mounted. Under maximum load conditions (with fully loaded semi-trailer) the frame is pressed closer to the axles causing the actuator lever to move upward. The maximum load setting permits full, unrestricted, signal pressure to reach both the left rear service brake relay valve (6) and the trailer service coupling. Decreasing the load causes the actuator lever to move downward, thus restricting air flow and reducing signal pressure. Reduced braking pressure under no-load conditions permits a smooth even stop and prevents wheel skid. The valve actuator lever acts through a hydraulic lapse-time device which presents change in the valve setting by normal road bumps.

d. Trailer Service Brake Air Supply System. The trailer service brake coupling supplies signal air pressure to the trailer brakes. The same load proportioned signal is supplied to the trailer that causes braking on the tractor when the pedal is depressed. The tractor service air line is connected to the trailer service air relay valve (22, fig. 2-170). The trailer service air relay valve responds to the pressure signal from the brake pedal by routing a strengthened air signal of equal pressure from the reservoir to the trailer service coupling. This results in faster trailer brake response. The trailer service air coupling is shut-off manually when the trailer is disconnected.

e. Trailer Brake Hand Control Valve. The trailer brake hand control valve (15) is mounted on the steering column. It provides separate modulated braking for the trailer to help control vehicle speed and stability while descending grades and to assist in recovering the vehicle from skids.

f. Auxiliary Service Fill and Outlet Couplings (fig. 2-170). An auxiliary service fill coupling (1) is provided at the front of the vehicle to supply service air to the vehicle when it is disabled and towed by another vehicle. An auxiliary service outlet is provided at the rear of the vehicle to supply service air to a towed and disabled vehicle equipped with a front service inlet coupling.

g. 3-Way Gage and Stoplight Pressure Switch (fig. 2-170). The 3-way gage (17), mounted on the cab right instrument panel, has three calibrated, dial-type, pressure gages. The gages are supplied by air lines with pressure information from the service reservoir, from the treadle valve service output chamber, and from the left rear service relay valve. The gages are marked "reservoir", "front", and "rear." Respectively, (1) system air pressure, (2) signal pressure delivered from the treadle valve and available to the front service relay valve, and (3) air pressure output of the rear service relay valve which reflects the signal modulation that has occurred in the proportioning valve. The stoplight pressure switch (19, fig. 2-170), located behind the front bumper, is connected by an air line to the treadle valve. When the brake pedal is depressed, pressurized air is routed to the stoplight pressure switch causing an electrical connection to be made in the stoplight circuit, energizing the stoplights.

h. Fail-Safe Brake System (fig. 2-171). The fail-safe power springs are held off by pressurized reservoir air which is supplied to the fail-safe air chambers by a relay valve (7) positioned at right rear of vehicle. A minimum of 65 psi air pressure is required to fully compress the power springs. The fail-safe relay valve is actuated by a constant pressure signal from the air line that passes through the parking/emergency brake control valve (1). When the parking/emergency brake control valve is set in the APPLY position, the air pressure signal is interrupted and the relay valve shuts off air supply to the fail-safes. Air pressure remaining in the fail-safe air chambers vents through the relay valve and the power springs apply the brakes. When the parking/emergency brake valve is set in the RELEASE position, signal pressure again reaches the fail-safe relay valve; reservoir air pressure is restored in the fail-safe air chambers and the brakes are released. If reservoir pressure drops below 65 psi, the fail-safe brakes will start to apply. When pressure drops below 65 psi, a pressure switch (2) will turn on the tractor low pressure warning light and the warning buzzer will sound.

j. Supply Tanks and Emergency Fill (fig. 2-171). The right supply tank is mounted under the vehicle frame on the right side and is interconnected to the left supply tank and wet tank. The supply tanks can be filled from an external air source through the emergency fill coupling located on the front bumper on the left side so that the service brakes can be operated when the vehicle is disabled and towed. The emergency fill coupling is used as a pressure source for inflating tires.

k. Trailer Emergency Air Line Supply System (fig. 2-171). When system air pressure is normal and the parking/emergency brake is off, pressurized air from the fail-safe signal air line passes through the two-way check valve (9) to the trailer emergency coupling and to the auxiliary (tow pintle) emergency coupling. However, if the parking/emergency brake is applied, air pressure to the trailer emergency coupling is exhausted along with fail-safe signal air line pressure. Depletion of air to the trailer emergency coupling causes the trailer brakes to apply. In order to again supply emergency air to the trailer while the tractor parking/emergency brake remains applied, the trailer "fill" air switch (3) must be pushed in. This allows pressurized air from the supply tank to bypass the parking/emergency brake control valve and to reach the trailer emergency coupling. The two-way check valve (9) prevents an air pressure signal from escaping to the fail-safe relay valve. The trailer "fill" valve handle may be pulled out manually to again cut off air to the trailer, or it may be left to be reset automatically when the emergency brake is released. The trailer emergency air supply is shut off manually by a shutoff valve (4) when the tractor is uncoupled from the trailer.

l. Low Pressure Warning Switch. The low pressure warning switch (2, fig. 2-171) is connected to the right side supply tank air line. When air pressure in the supply tanks drops below 65 psi, the low pressure warning switch is electrically activated, completing the circuit to the low pressure warning buzzer. When system pressure is low, the warning buzzer sounds.

m. Accessories Air System (fig. 2-184). The air tanks supply pressurized air to actuate the intertandem differential lockout mechanism. Differential lockout is controlled by a push-pull valve (6) in the cab. Pushed in, differential lockout occurs; pulled out, differential lockout ceases. Air pressure supplied to the intertandem differential lockout control valve (4) is reduced to 40 psi by the pressure regulator valve (2). The air tanks also supply air to the air horn, which is equipped with a solenoid valve that is activated by the steering column horn button. The accessories air system can be closed off to air supply at the manual shutoff valve (1) at the right side supply tank.

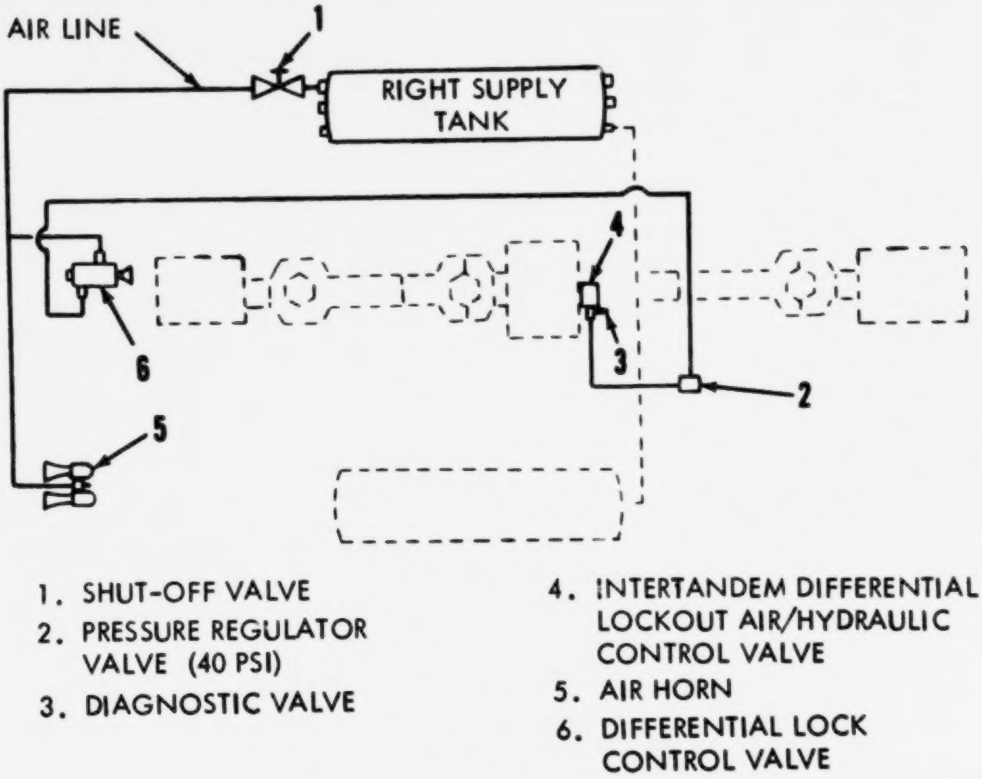

AIR LINE
1
RIGHT SUPPLY TANK
4
6
3
2
5
1. SHUT-OFF VALVE
2. PRESSURE REGULATOR VALVE (40 PSI)
3. DIAGNOSTIC VALVE
4. INTERTANDEM DIFFERENTIAL LOCKOUT AIR/HYDRAULIC CONTROL VALVE
5. AIR HORN
6. DIFFERENTIAL LOCK CONTROL VALVE
TA027622

Figure 2-184. Accessories air system schematic.

n. Sealed Air Vent System. Air at atmospheric pressure is vented from the non-pressure side of the brake air chambers and from the axles. This system assures that no vent ports are open to the atmosphere below the fording depth of the vehicle and also eliminates potential contamination from road splash.

o. Air Compressor and Reservoir System (fig. 2-170). (1) The air compressor (11) is engine mounted and belt driven. Cooling is provided by water lines from the engine cooling system. Lubrication is provided by engine oil. The compressor is a two cylinder, reciprocating piston type, and pumps air (governed) at 90 to 120 psi to the wet tank. In the wet tank, air, heated during compression, is cooled, and water vapor condenses. Moisture is collectd at the bottom of the wet tank from which it must be drained manually. The supply tanks are filled successively from the wet tank by interconnecting air lines. A safety valve (21) relieves air pressure at 145 to 150 psi. This relief feature is audible momentarily when the tanks are being filled from an empty condition. One-way check valves (9) and (10) at the wet tank inlet and outlet protect the system from loss of air pressure in the event of air compressor failure.

(1) Air system pressure is maintained at 90 to 120 psi through the air compressor governor. The air compressor cycles continuously while the engine is running. A signal line from the wet tank keeps the air compressor governor (13) in contact with reservoir air pressure. When reservoir air pressure reaches 120 psi, the governor opens and routes air at reservoir pressure to open both compressor cylinder inlets to a common passage. Air is thus merely pumped back and forth on the inlet side of the cylinders and no air is discharged. When reservoir air pressure falls to 90 psi, the governor closes and normal pumping action is resumed. A manual shutoff cock (12) is provided to cancel governor operation so that system pressure can reach 145 to 150 psi for tire inflation.

(3) The alcohol evaporator unit (14) releases alcohol vapor into the air compressor discharge line to prevent moisture in the system from freezing.

2-122. Tests and Procedures Used In Conjunction with Troubleshooting

a. General. The following procedures outline the necessary steps to isolate malfunctions to either the tractor or the trailer. This paragraph also includes the individual air system function and component tests necessary for troubleshooting. All tests for components are on-vehicle, in-system tests for convenience. Valves need not be removed unless they are to be replaced.

b. Test Points (Fig. 2-185). Eight diagnostic valves have been included in the air system. These valves, along with the air pressure gage mounted in the cab, provide a total of eleven test points (TP) where pressure checks can be made without disconnecting components. A tire pressure gage is used to check pressures at the diagnostic valve TP's. The eleven TP's are used in conjunction with the test procedures to isolate the trouble to the tractor or the trailer, then to the system malfunctioning, and finally to the faulty component.

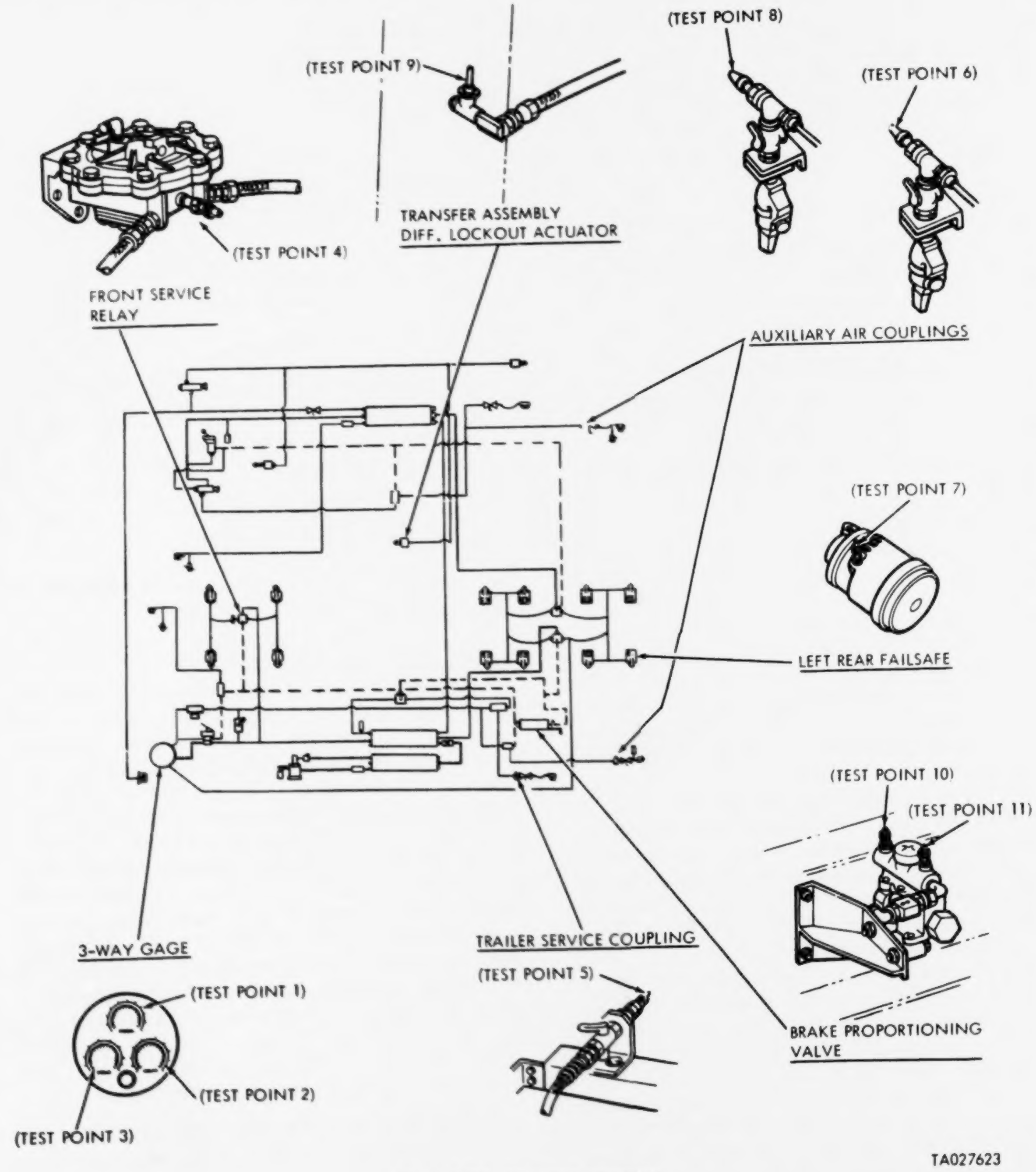

(TEST POINT 9)
(TEST POINT 8)
(TEST POINT 6)
(TEST POINT 4)
TRANSFER ASSEMBLY DIFF. LOCKOUT ACTUATOR
FRONT SERVICE RELAY
AUXILIARY AIR COUPLINGS
(TEST POINT 7)
LEFT REAR FAILSAFE
(TEST POINT 10)
(TEST POINT 11)
3-WAY GAGE
TRAILER SERVICE COUPLING
(TEST POINT 5)
(TEST POINT 1)
(TEST POINT 2)
(TEST POINT 3)
BRAKE PROPORTIONING VALVE
TA027623

Figure 2-185. Air system test points.

NOTE

Before making following checks and tests, close shutoff valves at both EMERGENCY and both SERVICE couplings.

c. System Pressurization and Leakage Check. With parking/emergency brake applied, start engine and operate at 1500 rpm. Observe reservoir pressure gage (TP 1) and check time it takes for gage to indicate 90 to 120 psi.

(1) If time to reach 90 to 120 psi is seven minutes or less, continue with test; compressor is functioning normally. If time is more than seven minutes, refer to *i* below and perform reservoir and compressor system checks.

(2) With shift in neutral, release parking/emergency brake. Fully depress brake treadle for service brakes. Note pressure indicated on reservoir pressure gage and hold treadle depressed for two minutes and again note pressure.

(a) If pressure is less than 6 psi, leakage rate is acceptable.

(b) If pressure drop is more than 6 psi in two minutes, refer to *w* below and perform air lines, air reservoir, and air valve leakage tests and inspections.

d. Parking/Emergency Brake Checks. With reservoir pressure at operating range of 90 to 120 psi and parking/emergency brake applied, push trailer fill air valve IN and check pressure at TP 7, located at vehicle right rear, and 8, located on left rear fail-safe brake. Pressure at TP 8 should be within 5 psi of reservoir pressure at TP 7. Release parking/emergency brake and check pressure at TP 7. Pressure at TP 7 should be within 5 psi of reservoir pressure. In both of these tests, pressure at TP 7 and TP 8 should be available without delay after actuating the necessary control. Visually inspect fail-safe air lines and hoses for damage or kinks and listen for any air leakage from lines or brake actuators. Carefully open shut-off valve, slightly, at gooseneck emergency coupling and then the rear auxiliary EMERGENCY coupling and listen for escaping air. (Trailer air hoses disconnected.)

(1) If the pressures at TP7 and TP8 are normal, no leaks are found and air escapes from EMERGENCY couplings when shutoff valves are opened, the tractor parking/emergency brake system is functioning normally. Troubleshoot trailer for parking brake trouble.

(2) If the pressure at TP 8 is low, erratic, or slow acting when trailer emergency fill valve is actuated with parking/emergency brakes applied, inspect air lines from EMERGENCY couplings to two-way check valve No. 5 (9, fig. 2-171) for damage or kinks. Two-way check valve is adjacent to supply tank on vehicle right side. If no damaged air lines are found, perform tests on two-way check valve. Refer to *v* (1) below.

(3) If trailer emergency fill valve handle does not pop out when parking/emergency brakes are released, perform checks on the parking/emergency brake valve and trailer emergency fill valve (*v* below).

(4) If pressure at TP 7 is zero, low, or slow acting, perform checks on fail-safe relay valve (*j* below), and checks on parking/emergency brake control valve (*v* below).

e. Service Brake Checks. Close both gooseneck and rear SERVICE coupling shutoff valves. Operate vehicle engine to bring reservoir pressure, TP 1, up to the normal operating range of 90 to 120 psi. Apply parking brakes. Observe FRONT and REAR pressure gages (TP 2 and TP 3) and use tire gage to check pressure at TP 4 as brake pedal is slowly depressed to full travel and slowly released. The pressues at TP 2, TP 3, and TP 4 should vary smoothly and without hesitation as position of the brake pedal is changed. The pressures should vary from 0 psi to maximum psi as pedal is depressed and return to 0 psi as pedal is released. The following maximum pressures should be observed.

TP 2 - 90 to 120 psi - within 5 psi of reservoir pressure.
TP 3 - (No trailer on fifth wheel) - 30 to 60 psi.
TP 3 - Empty trailer on fifth wheel - 60 to 90 psi.
TP 3 - (Fully loaded trailer on fifth wheel) - 90 to 120 psi - within 5 psi of reservoir pressure.
TP 4 - 90 to 120 psi - within 5 psi of reservoir pressure.
TP 5 - Same as TP 3.

Repeat check using tire gage to check pressure TP 5 located vehicle left side at gooseneck interconnect and again to check pressure at TP 6, as the brake pedal is fully depressed and released. The pressure at TP 5 should vary to the same maximum as given above for TP 3. Pressure at TP 6 should vary from 0 psi to maximum as pedal is depressed and return to 0 psi as pedal is released. Maximum pressure observed should be 90 to 120 psi - within 5 psi of reservoir pressure.

(1) If pressures at TP 1, TP 2, TP 3, TP 4, TP 5, and TP 6 are normal, tractor service brake air system is functioning normally when using the service brake pedal. Check shutoff valve, intervehicular connecting hose, and SERVICE couplings for damage. Open shutoff valves, depress brake pedal slightly, and listen for air being exhausted from coupling. If air is being exhausted, recouple SERVICE hose to trailer, open shutoff valve, and troubleshoot trailer for service air malfunctions.

(2) If the pressure at TP 1 is normal, but pressures at TP 2, TP 3, TP 4, TP 5, and TP 6 are 0 psi, low, uneven, or erratic, perform treadle valve checks (*k* below).

(3) If pressures at TP 1, TP 2, and TP 3 are normal, but pressure at TP 4 is 0 psi, low, uneven, or erratic, perform checks on front service relay valve (l below).

(4) If pressures TP 1 and TP 2 are normal, but TP 3 is 0 psi, low, uneven, or erratic, perform checks on proportioning valve (*o* below) and rear service relay valve (*m* below).

(5) If pressures at TP 1, TP 2, and TP 3 are normal, but pressure at TP 5 is 0 psi, low, uneven, or erratic, perform checks on the trailer service air relay valve (22, fig. 2-170). Refer to *n* below.

(6) If pressures at TP 1, TP 2, TP 3, TP 4, and

TP 5 are normal, but pressure at TP 6 is 0 psi, low, uneven, or erratic, perform checks on two-way check valve No. 2 (24, fig. 2-170) at proportioning valve. Refer to *r* below.

(7) If pressures at TP 1 and TP 2 are normal, but pressure at TP 3 and TP 4 are both 0 psi, low, uneven, or erratic, perform checks on two-way check valve No. 1 (20, fig. 2-170) left of front relay valve. Refer to *q* below.

(8) If pressures at TP 1, TP 2, TP 4, and TP 5 are normal, but pressure at TP 3 is 0 psi, low, uneven, or erratic, perform checks on rear service relay valve (*m* below).

f. Trailer Hand Control Brake System Checks. Close both SERVICE coupling shutoff valves, located at left gooseneck interconnect and trailer left rear. Apply parking brakes and operate engine to bring reservoir pressure, TP 1, up to normal operating pressure range of 90 to 120 psi. Use tire gage to measure pressure at TP 5 and then at TP 6 as trailer hand control valve lever is moved slowly through full travel and returned. The pressures at TP 5 and TP 6 should vary smoothly, evenly, and without delay as the control lever is moved. Maximum pressure at full lever travel should be equal to reservoir pressure.

(1) If the pressures at TP 5 and TP 6 are normal, trailer hand brake control system is functioning normally. Troubleshoot trailer for service brake malfunctions.

(2) If pressure at TP 5 is normal, but pressure at TP 6 is 0 psi, low, uneven, or erratic, perform checks on two-way check valve No. 2 (24, fig. 2-170) at proportioning valve. Refer to *r* below.

(3) If pressure at TP 6 is normal, but pressure at TP 5 is 0 psi, low, uneven, or erratic, perform checks on two-way check valve No. 3 (23, fig. 2-170) at trailer relay valve. Refer to *s* below.

(4) If pressures at TP 5 and TP 6 are both 0 psi, low, erratic, or uneven, perform checks on trailer brake hand control valve (15, fig. 2-170). Refer to *p* below.

g. Auxiliary Air System Checks.

(1) Operate engine until reservoir pressure, TP 1, is up to normal operating range of 90 to 120 psi. Push differential lockout control valve (6, fig. 2-184) IN and check pressure at TP 9, located at transmission transfer case rear. The pressure at TP 9 should be 35 to 45 psi. Pull valve OUT. Pressure at TP 9 should drop to 0 psi.

(2) Observe tractor low pressure warning light. If reservoir pressure is 6 psi, or greater, the light should be off. If light is not off, or it does not light on press-to-test check, refer to electrical troubleshooting.

(3) Press air horn button to check operation. If it does not sound, refer to troubleshooting table.

h. Procedure at Finish of Checks. If all pressure checked in *a* through *g* above are normal and no leaks are found in the tractor, the M746 air brake control system is operating normally. Open shutoff valves to trailer (if trailer is connected) before returning vehicle to service or using vehicle to troubleshoot the trailer.

i. Compressor and Reservoir System Tests.

(1) *Low pressure malfunction.*

(a) If reservoir pressure does not reach 90 to 120 psi during tests in *c* above, inspect compressor and governor hoses, reservoir air lines, and supply lines to the relay valves for leakage.

(d) Deplete reservoir pressure and remove compressor delivery hose and one-way check valve (10, fig. 2-170). Check for clogging and proper operation of check valve. Check operation of service tank one-way check valve (9, fig. 2-170) and inspect air lines connecting the wet tank to service and emergency reservoirs for damage or kinks.

(c) If no leaks are found in tests *(a)* and *(b)* above, close governor shutoff valve (12, fig. 2-170) and operate engine at 1000 rpm. Reservoir pressure should reach 145 to 150 psi. If the pressure reaches 145 to 150 psi, governor is causing the low pressure problem. Open governor shutoff valve and adjust governor to a reservoir pressure of 115 to 120 psi (para 2-128*i*). If pressure does not reach 145 to 150 psi with the shutoff valve closed, compressor drive belts are slipping or compressor is defective. Tighten or replace compressor drive belts or replace compressor (para 128*c*).

(2) *Excessive pressure malfunction.* Assure that governor shutoff valve (12, fig. 2-170) is open and adjust governor for 90 to 120 psi (para 2-128*i*). If trouble persists, deplete reservoir pressure. Remove governor pressure hose and shutoff valve and check for proper functioning of the valve or clogging of the hose. If hose and shutoff valve are clear and functioning, compressor governor is defective. Replace compressor governor (para 2-128).

(3) *Safety valve test.* With governor shutoff valve closed and engine running, observe reservoir pressure gage and check for air being released from safety valve (fig. 2-189). With gage indicating 150 psi, air should escape audibly from valve. If gage indicates more than 150 psi, or air does not escape from valve, replace safety valve (fig. 2-189)

j Fail-Safe Relay Valve Tests

(1) If the pressure at TP7 during tests in *d* above is low, visually inspect fail-safe signal air line and supply air line (fig. 2-171) from reservoir to fail-safe relay valve, for kinks or damage closing off the lines. Apply parking/emergency brakes and disconnect fail-safe signal air line from relay valve. Partially release parking/emergency brake to check for a strong air signal to valve. CAREFULLY loosen fitting on supply tank air line at valve and listen for air escaping. If air pressure is available to both relay valve ports, replace relay valve (para 2-126).

(2) If pressure at TP 7 is 65 psi or above, but fail-safe brakes will not apply, move parking/emergency brake control lever from RELEASE position and check for air venting from relay valve vent. If venting does not occur, repeat procedure and check for venting at parking/emergency brake control valve. If venting occurs, replace relay valve (para 2-126). If not, see *v*(3) below.

k. Treadle Valve Tests.

(1) Depress treadle slowly to full depression while observing the front pressure gage in the cab. Gage needle should move smoothly and without hesitation as treadle is moved. With pedal fully depressed, front pressure gage reading should be within 5 psi of reading on RESERVOIR pressure gage. If pressure on gage is zero, low, or erratic when brake treadle is depressed, the treadle valve is defective.

(2) Depress brake treadle and check for venting of air from valve vent when pedal is released. If no air is vented, the tradle valve is defective. Replace valve (para 2-124*b*).

(3) Hold treadle fully depressed (90 to 120 psi on gage) and check for leakage at air line fittings, valve body, or valve vent. Tighten or repair any leaking fittings or lines. Leakage from valve body or vent indicates that valve is defective. Replace valve (para 2-124*b*).

l. Front Service Relay Valve Tests.

(1) If pressure at TP 4 is low during test in *e* above, visually inspect signal air line, and reservoir air line to relay valve, for kinks restricting air and then depress treadle to check for air signal to the relay valve. Carefully loosen fitting on reservoir air line and check for presence of reservoir pressure at valve. If both pressures are present, replace relay valve (para 2-126).

(2) If front tandem brakes do not release, apply treadle valve and check for air venting from relay valve vent when treadle is released. If this venting does not occur, relay valve is defective. Replace valve (para 2-126).

(3) Without depressing treadle valve pedal, check for presence of pressure at TP 4. If pressure is present, relay valve is defective. Replace valve (para 2-126).

m. Rear Service Relay Valve Tests.

(1) If pressure at TP 3 during tests in *e* above is not normal, visually inspect (1) signal air line from proportioning valve to relay valve and (2) reservoir line from supply tank to relay valve, for kinks or damage closing off the lines. Depress treadle and check pressure at TP 11. Refer to *o* below for normal pressure readings. Continue with test *o* below if pressure is not normal. CAREFULLY loosen fitting on reservoir air line and check for presence of reservoir pressure at relay valve. If both pressures are present, replace rear service relay valve (para 2-126).

(2) If rear service brakes do not release, depress brake pedal and check air venting from rear service relay valve vent when pedal is released. If this venting does not occur, relay valve is defective. Replace valve (para 2-126).

(3) Without depressing treadle valve pedal, check for pressure at TP 3 (rear pressure gage) for presence of pressure. If pressure is present, valve is defective. Replace relay valve (para 2-126).

n. Trailer Service Air Relay Valve Tests.

(1) If pressure at TP 5 is not normal during test *e* above, visually inspect (1) air [illegible] from signal port of valve to proportioning valve output, (2) reservoir line from relay valve to service tank, and (3) air line from relay valve to trailer service coupling for damage or kinks closing off the air lines. Depress treadle and check the pressure at TP 11. Refer to test *o* below for pressure readings. If pressure is not normal, continue test *o*. Remove signal line at relay valve and depress treadle to check for an air signal to the relay valve. CAREFULLY loosen fitting on reservoir air line and check for presence of reservoir air to the relay valve. If both pressures are present, replace relay valve (para 2-126).

(2) If trailer service brakes are not releasing, depress treadle valve pedal and check for air venting from relay valve vent when pedal is released. If venting does not occur, relay valve is defective. Replace relay valve (para 2-126).

(3) With tire gage, check pressure at TP 5 as treadle is depressed and released. There should be no delay in the pressure build-up or return to 0 psi. If any pressure remains after pedal release or a delay in pressure returning to 0 psi, inspect the hose and signal air line to the relay valve for damage, kinks, or clogging. If none is found, valve is defective. Replace relay valve (para 2-126).

(4) Depress treadle valve pedal fully and check at relay valve vent for evidence of air escaping. If air is escaping, valve is defective. Replace relay valve (para 2-126).

o. Proportioning Valve Tests.

(1) With reservoir pressure up to normal operating range (90 to 120 psi), fully depress service brake pedal and check pressure at TP 10 using tire gage. Pressure should be within 5 psi of reservoir pressure. Hold pedal depressed and check pressure at TP 11. The pressure should be one of the following:

(*a*) Tractor alone - 30 to 60 psi.

(*b*) Tractor connected to empty M747 trailer - 60 to 90 psi.

(*c*) Tractor connected to M747 trailer with an M60-type vehicle aboard - 90 to 120 psi.

If pressure is high or low, adjust actuator lever linkage to obtain proper pressure (para 2-127*c*). If proper pressure cannot be obtained with adjustment, replace proportioning valve (para 2-127*b*).

(2) Fully depress treadle valve pedal and check porportioning valve, fittings, vent and air lines for leakage. If leakage is detected in valve body or at vent, replace valve (para 2-127*b*).

p. Trailer Brake Hand Control Valve Tests.

(1) If pressure observed at TP 5 and TP 6 during tests in *f* above was not normal, visually inspect (1) signal lines from trailer brake hand control valve to the SERVICE couplings and (2) reservoir line for damage or kinks. Loosen signal line fitting at valve and actuate valve to check for pressure being delivered by valve. If no air is delivered, replace valve (para 2-124).

(2) If the pressure delivered to both TP 5 and TP 6 is not equal to reservoir pressure, valve is defective. Re-

place valve (para 2-124).

(3) Move hand control valve to the fully open position and then close it while checking for air escaping from the valve vent located behind dash panel. If this venting does not occur, the valve is defective. Replace valve (para 2-124).

(4) With valve fully closed, check for presence of pressure at TP 5 and TP 6. If pressure is present, valve is defective. Replace valve (para 2-124).

q. Two-Way Check Valve No. 1 Tests.

NOTE

Two-way check valve No. 1 (20, fig. 2-170) is left of front tandem relay valve.

(1) If both pressure at TP 3 and TP 4 are zero, or erratic during test in *e* above, two-way check valve is defective. Replace check valve.

(2) With treadle valve fully depressed, remove dummy coupling from service fill coupling on front bumper and check for leakage. If any leakage is noted at coupling, check valve is defective. Replace check valve.

(3) Apply air at service fill coupling and check for air venting from treadle valve exhaust port. If venting is present, check valve is defective. Replace check valve.

(4) Depress treadle and release it. Assure that pressure at TP 2 (front pressure gage) returns to 0 psi. Check for presence of pressure at TP 4 and TP 10. If pressure is present at *both* TP 4 and TP 10, two-way check valve No. 1 is defective. Replace check valve.

r. Two-Way Check Valve No. 2 Tests.

NOTE

Two-way check valve No. 2 (fig. 2-193) is at proportioning valve.

(1) If pressure at TP 6 is not normal during the tests in *e* above when both the treadle valve and the trailer brake hand control valve are actuated, either the check valve is defective or the line between the valve and TP 6 is damaged. Replace check valve (fig. 2-193) if no line damage is found.

(2) With trailer brake hand control valve fully open, use tire gage to check for presence of pressure at TP 10. If pressure is present or air vents from treadle exhaust port, check valve is defective. Replace check valve.

(3) Depress treadle valve pedal fully and check at trailer brake hand control valve for escaping air. If air is being vented, two-way check valve No. 2 is defective. Replace check valve.

s. Two-Way Check Valve No. 3 Tests.

NOTE

Two-way check valve No. 3 (23, fig. 2-170) is located at trailer service air relay valve.

(1) If pressure at TP 5 is zero, low, or erratic during both test *e* and *f* above, visually inspect signal air line from check valve to trailer service coupling shutoff valve, for damage or kinks closing off the line. If no damage is found, two-way check valve No. 3 is defective. Replace check valve.

(2) Actuate trailer brake hand control valve to full application. Check vent to trailer relay valve for escaping air. If air is vented, two-way check valve is defective. Replace check valve. If no air escapes, reconnect check valve.

(3) Depress treadle valve pedal fully. Check for air escaping from vent of trailer brake hand control valve. If air is vented, two-way check valve is defective. Replace check valve.

t. Two-Way Check Valve No. 4 Tests.

NOTE

Two-way check valve No. 4 (18, fig. 2-170) is located under the cab front center.

(1) Observe stoplights and depress brake pedal and release, then actuate the trailer brake hand control and release. If stoplights do not come on or go off in each case, two-way check valve No. 4 may be defective; however, see electrical section before repairing. Replace check valve.

(2) Actuate trailer brake hand control and check for leakage at vent port of treadle valve. If leakage is present, two-way check valve No. 4 is defective. Replace check valve.

(3) Depress brake pedal and check for leakage at vent port of trailer brake hand control valve. If leakage is present, two-way check valve No. 4 is defective. Replace check valve.

(4) If stoplights do not operate when either service brake treadle or trailer brake hand control are actuated, refer to Electrical Troubleshooting Table 2-26.

u. Two-Way Check Valve No. 5. Refer to *v* below.

NOTE

Two-way check valve No. 5 (9, fig. 2-171) is located right of the supply tank on right side of vehicle.

v. Parking/Emergency Brake Control Valve and Trailer Fill Valve Test.

(1) With the system fully charged and the parking/emergency brakes applied, push the trailer fill knob IN and check pressure at TP 7 and TP 8. If the pressure at TP 7 is 0 psi and TP 8 is within 5 psi of reservoir pressure, the fill valve and two-way check valve No. 5 are functioning normally. If TP 7 is pressurized, two-way check valve No. 5 is defective. Replace check valve.

(2) With system fully charged and trailer fill valve knob IN, release parking/emergency brakes. Observe trailer fill valve knob and check pressures at TP 7 and TP 8. If fill valve knob pops out and pressures at TP 7 and TP 8 are both within 5 psi of reservoir pressure, system is operating normally. If the fill valve knob does not pop out, the trailer fill valve is defective. Replace valve (5, fig. 2-188). If pressure at TP 7 is not within 5 psi of reservoir, the parking/emergency control valve or the fail-safe relay valve is defective. Refer to test *j* above for test of relay valve. If no signal reaches relay valve, replace parking/emergency brake control valve (para 2-124).

(3) With air system fully charged, release and apply parking/emergency brakes and check for air escaping from exhaust vent in the control valve (8, fig. 2-188). If air does not exhaust from vent as brakes apply, valve is de-

fective. Replace valve (para 2-124).

w. Air Lines, Air Reservoir, and Air Valve Leakage Tests and Inspection.

(1) *Air line leakage test.* If leaks are suspected, coat air lines, couplings, and connections with soapy water and watch for bubbles. Tighten fittings on lines and hoses that show evidence of leakage. Inspect lines for restrictions caused by dents, kinks, or clogging. Inspect hose assemblies for wear, cuts, breaks, or clogging. Replace tubing, hose, or fitting if damaged, or if leaks cannot be stopped.

(2) *Air reservoir leakage tests.* With the air system charged, coat drain cocks and tubing connections with soapy water. No leakage is permissable. Tighten any leaking connection. Inspect reservoirs for damage or corrosion. Replace reservoirs that leak at the welds, are damaged, or are corroded. Open drain cocks fully on ALL reservoirs DAILY and allow moisture to drain. Close drain cocks after draining.

(3) *Air valves leakage tests.*

(a) Fail-safe relay valve. With air system fully pressurized and parking emergency brakes released, apply soapy water to flanges of fail-safe relay valve which retain the diaphragm, and to service air line fittings at valve. No leakage is permitted. Tighten flange nuts and fittings as required. With parking/emergency brakes applied, coat exhaust port of relay valve with soapy water. Leakage must not exceed a 1-inch bubble in three seconds. If leakage is excessive, replace relay valve (para 2-126).

(b) Front tandem, rear tandem and trailer service air relay valves. With air system fully pressurized and the brake treadle fully depressed, repeat flange leakage test as in *(a)* above. With treadle released, repeat exhaust port test as in *(a)* above.

(c) Treadle valve. With air system fully pressurized and the treadle fully depressed, coat valve and connections with soapy water. No leakage is permitted. Tighten fittings as required. Leakage from exhaust port must not exceed a 1-inch bubble in three seconds. With treadle released, apply soapy water to valve vent. Leakage must not exceed a 1-inch bubble in three seconds. If leakage is excessive, replace valve.

(d) Parking/emergency brake control valve. With system fully pressurized and the parking/emergency brakes released, repeat test *(c)* above for leakage at exhaust port.

(e) Proportioning valve. With system fully pressurized and treadle fully depressed, coat valve, test points, fitting, and vent with soapy water. No leakage permitted at valve, connections, or test points. Tighten fittings as required. Leakage at vent must not exceed a 1-inch bubble in three seconds. If leakage is excessive, replace the proportioning valve.

(f) Trailer hand brake control valve. With system fully pressurized and control valve in the applied position, coat valve fittings and vent with soapy water. No leakage permitted at valve or fittings. Tighten or replace fittings as required. Leakage at vent must not exceed a 1-inch diameter bubble in three seconds. If leakage is excessive, replace the valve.

(g) Intertandem differential lockout pressure regulator valve. With system fully pressurized and the differential lock-out valve pushed in, make the leakage checks as given in *(f)* above.

(4) *Brake actuators, fail-safe and service.*

(a) Fail-safe chambers (rear wheels only) (fig. 2-159.) With system fully pressurized and the parking brakes released, coat area around caging bolt, cap lock ring, fitting, and clamping ring to check for leakage. No leakage is permissible. If leakage is found at emergency connections, tighten fittings. If leakage is found at cap lock ring, caging bolt, or at flange clamping ring, cage (refer to para 2-116) fail-safe and remove it for replacement.

(b) Service brake chamber (all wheels). With system fully pressurized and service brake treadle fully depressed or with an air hose connected to front auxiliary service coupling, check for leakage at the chamber housing flanges and the service air connections. No leakage is permissible. If leakage is found at connection, tighten fitting or replace fitting as required. If leakage is found at flange, tighten air chamber clamp ring bolts evenly. If leakage persists, release the pressure and replace the diaphragm.

NOTE

Cage fail-safe before removal if leak is at a rear wheel.

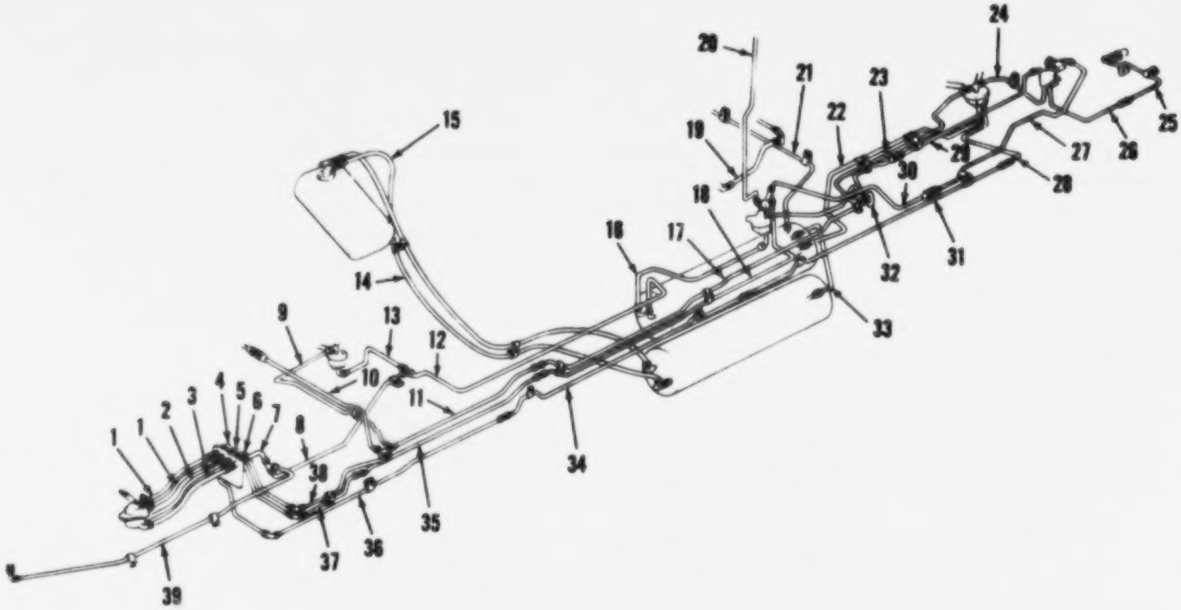
2-123. Air System Lines and Fittings Replacement

a. General. The air system lines consist of copper tubing, nylon tubing, and non-swivel type hoses. Copper tubing is either ¼-, ⅜- or ⅝-inch od size. Nylon tubing is either ⅜- or ⅝-inch od size. A typical air system tubing and hose installation is found in figure 2-186.

b. Fabrication and Installation of Copper Tubes. A copper line requiring replacement is made from copper tubing cut to appropriate length, bent to shape of tube being replaced, sleeves and nuts installed on each end, connected to appropriate fittings and secured with clamps and straps as required.

(1) *Bend radii limits.* Centerline bend radius for a ¼ od copper line shall not be less than 0.75 inch. Bend radius for a ⅜ copper line shall not be less than 1.12 inch, and for a ⅝ line shall not be less than 1.88 inch.

(2) *Nut and sleeve installation.* Nuts and sleeves installed on tube ends are components of particular fitting to which tube end is attached. Place nut and sleeve over tube end and insert tubing in fitting body so it bottoms. Tighten nut to obtain positive seal. Nut does not have to touch fitting body but must be torqued to valve indicated in (3) below. An alternate method of installing nut and sleeve is to insert tube end through nut and sleeve, in-



1 Hose, 40 in.
2 Hose, 48 in.
3 Hose, ½ id, 48 in.
4 Tube, copper, ¼ od, 29.25 in.
5 Tube, copper, ⅜ od, 21 in.
6 Tube, copper, ⅜ od, 23.75 in.
7 Tube, copper, ⅜ od, 8 in.
8 Tube, copper, ⅜ od, 32.75 in.
9 Tube, copper, ⅜ od, 41 in.
10 Tube, copper, ⅜ od, 38 in.
11 Tube, copper, ⅜ od, 38 in.
12 Tube, copper, ⅜ od, 78 in.
13 Tube, copper, ⅜ od, 21.5 in.
14 Hose, compressor outlet in.
15 Hose, compressor inlet in.
16 Tube, copper, ⅜ od, 48 in.
17 Tube, copper, ⅜ od, 75 in.
18 Tube, copper, ⅜ od, 81.75 in.
19 Hose, 21 in.
20 Tube, copper, ⅜ od, 49.32 in.
21 Tube, nylon, ⅜ od, 56 in.
22 Tube, copper, ⅜ od, 70.75 in.
23 Tube, copper, ⅜ od, 80.25 in.
24 Tube, copper, ⅜ od, 24.50 in.
25 Tube, copper,⅜ od, 29 in.
26 Tube, copper, ⅜ od, 27.75 in.
27 Tube, copper, ⅜ od, 59.38 in.
28 Tube, copper, ¼ od, 30.00 in.
29 Tube, copper, ⅜ od, 52.5 in.
30 Tube, copper, ⅜ od, 4.5 in.
31 Tube, copper, ¼ od, 68.38 in.
32 Tube, copper, ⅜ od, 37 in.
33 Tube, nylon, ⅜ od, 28 in.
34 Tube, copper, ¼ od, 71 in.
35 Tube, copper, ⅜ od, 51 in.
36 Tube, copper, ¼ od, 56 in.
37 Tube, copper, ⅜ od, 18.75 in.
38 Tube, copper, ⅜ od, 27.25 in.
39 Tube, copper, ⅜ od, 74 in.

Figure 2-186. Air system tubing and hose installation, left side.

stalled on fitting, until tube end bottoms in fitting body and nut then is torqued as indicated in following.

(3) *Nut torque values.* Nuts on ¼ od tubing are to be torqued to 60-150 pounds inch value, which is approximately one and one-half turns of nut after finger-tight. For nut on ⅜ od tubing, torque value is 85-225 pounds inch and for ⅝ od tubing, value is 200-400 pounds inch. All values are for dry condition.

c Replacement of Nylon Lines. Flexible nylon line is replaced by cutting appropriate od nylon tubing to length of line being replaced, installing nylon insert in each end of tube, and assembling nuts and sleeves in same manner as (2) above. Torque values for nuts on nylon tubing are as outlined in (3) above.

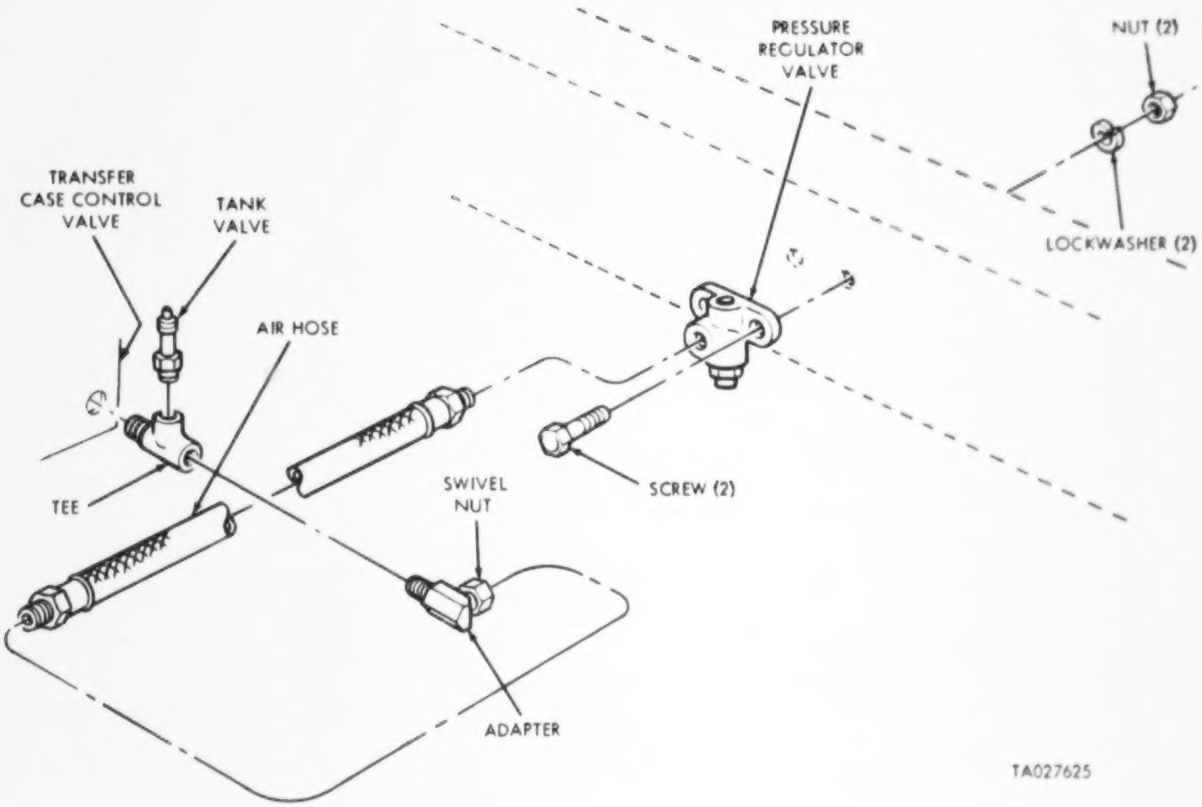
d. Removal of Non-Swivel Type Hoses. Most hoses in air system have fixed male pipe ends. To remove hose, fitting with nut in which hose end is inserted must first be separated from hose end. For example, to remove air hose (fig. 2-187) between pressure regulator valve and fittings at transfer case control valve, swivel nut of adapter must first be unscrewed from hose while hose is prevented from twisting. When hose connection at adapter swivel nut is broken, other hose end can be separated from pressure regulator valve.

e. Installation of Air System Hoses.

WARNING

> Particles blown by compressed air are hazardous. Make certain air stream is directed from user and other personnel in area.

Blow out each hose assembly with compressed air before installation. Wrap pipe thread ends of hose with teflon tape according to instructions in *f* below. Install hose end first into fixed device or fitting and then retain other end with nut at fitting. Be sure hose is not twisted when being



Figures 2-187. Removal of air hose between transfer case control valve and pressure regulator valve.

installed and that hose is not bent in too sharp a radius.

f. Wrapping Pipe Threads with Teflon Tape. All air system fittings, valves and hoses containing pipe threads require teflon tape, MIL-T-27730, type I or II depending on size, be applied to pipe threads before installation. This is done to provide better seal and also to permit easier removal. Method of teflon-wrapping pipe threads is as follows:

(1) Be sure pipe threads of item are thoroughly clean and dry before applying teflon tape. All dirt, grease, oil, and scale must be removed.

(2) Start tape one or two threads from small or leading edge of thread, joining tape together with overlap of approximately ⅛ inch.

(3) Wrap tape tightly in same direction as you would turn a nut. Tape must be pressed into the minor diameter of threads without cutting or ripping tape.

2-124. Cab Air System Components Replacement

a. General. Air lines leading to cab terminate at the trailer brake valve (1, fig. 2-188), air pressure gage (2), trailer air supply valve (5), differential air supply valve (7), emergency brake control valve (8), and brake treadle valve (*b* below). To replace these assemblies, except treadle valve, separate copper tubes at fittings installed in these assemblies, remove fittings, and remove mounting hardware. A typical arrangement of tubing to cab is shown in figure 2-189. After assembly is mounted in cab, install fittings wrapped with teflon tape as outlined in paragraph 2-123*f*, and secure tubing to appropriate fitting, tightening nut as outlined in paragraph 2-123*b*(3).

b. Brake Treadle Valve Removal.

(1) Two hoses (fig. 2-190) leading to treadle valve must first be separated from unions (fig. 2-191) at left side bulkhead beneath cab.

(2) Separate larger diameter hose from treadle valve (fig. 2-190). Separate smaller hose from bushing. Remove street elbow along with bushing from treadle valve.

(3) Separate tubing nuts from adapters and elbows in treadle valve. Remove adapters and elbows from valve.

(4) Remove three nuts and lockwashers from screws securing treadle valve to cab floor. Remove treadle valve from cab floor.

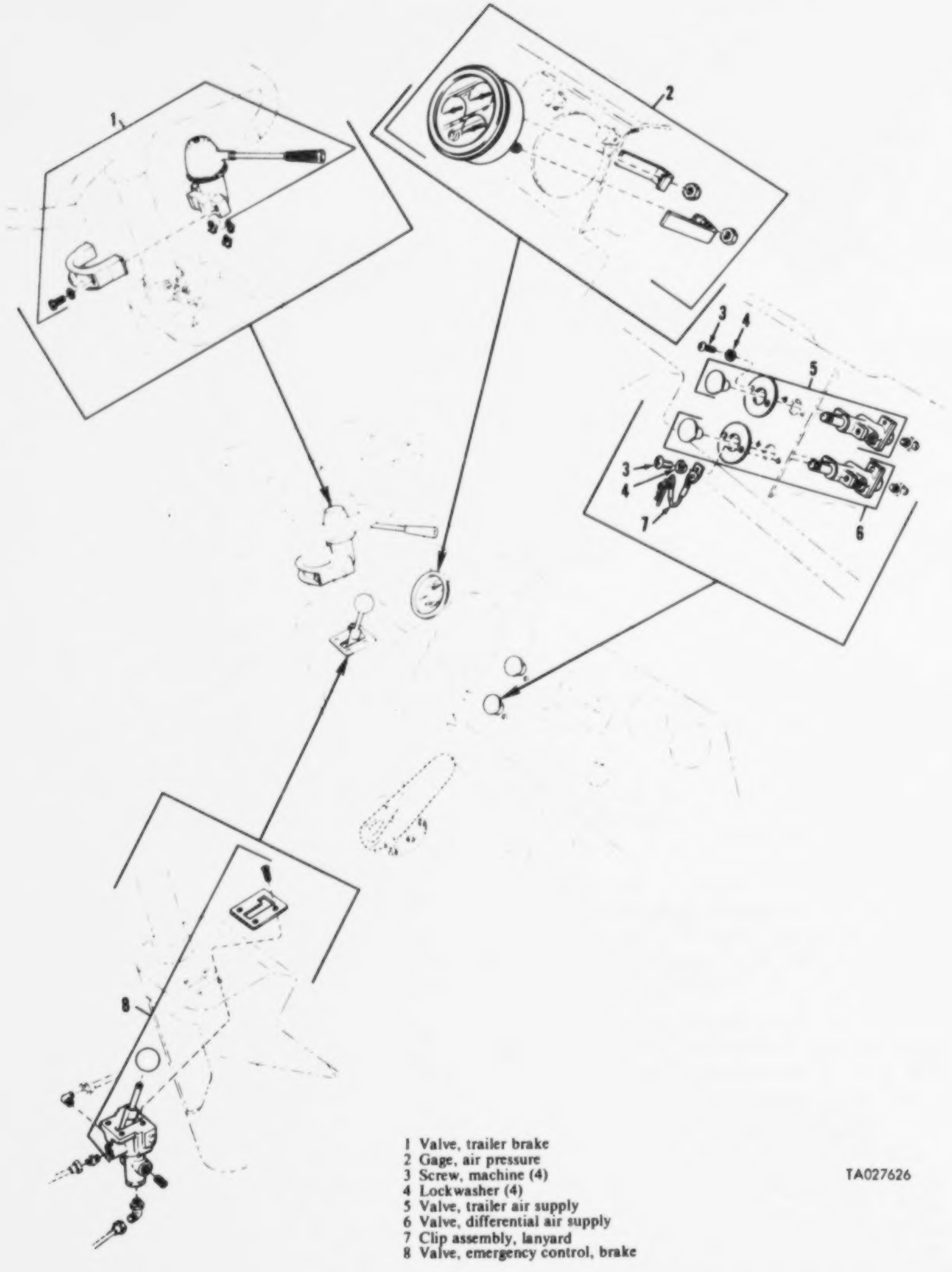
(5) If treadle valve requires replacement, remove two pipe plugs from valve unused ports.

c. Treadle Valve Installation.

NOTE

All male pipe threads are to be wrapped with teflon tape as outlined in paragraph 2-123*f* before installation in following procedures.

(1) If previously removed, install two pipe plugs



1 Valve, trailer brake
2 Gage, air pressure
3 Screw, machine (4)
4 Lockwasher (4)
5 Valve, trailer air supply
6 Valve, differential air supply
7 Clip assembly, lanyard
8 Valve, emergency control, brake

TA027626

Figure 2-188. Trailer brake valve, air pressure gage, trailer air supply valve, differential air supply valve, and emergency brake control valve.

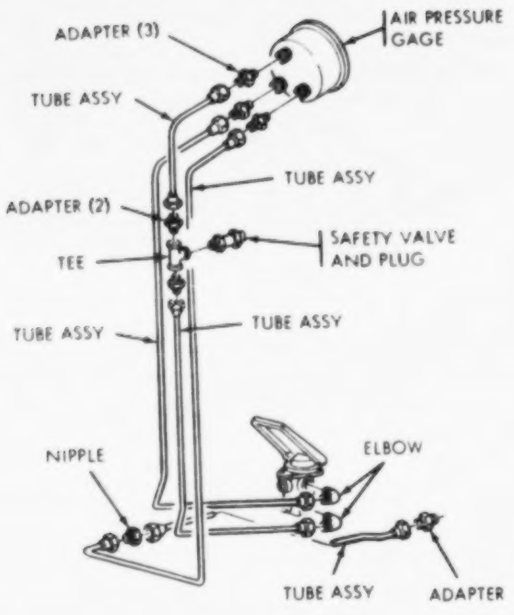

ADAPTER (3)
AIR PRESSURE GAGE
TUBE ASSY
TUBE ASSY
ADAPTER (2)
SAFETY VALVE AND PLUG
TEE
TUBE ASSY
TUBE ASSY
NIPPLE
ELBOW
TUBE ASSY
ADAPTER
TA027627

Figure 2-189. Air pressure gage air lines and fittings.

(fig. 2-190) in treadle valve ports as shown.

(2) Position treadle valve on cab floor and secure with three screws, lockwashers, and nuts. Torque nuts to 13-17 lb.-ft.

(3) Install tubing elbow and fitting bodies in appropriate valve ports and securing tubing nuts by tightening nuts as outlined in paragraph 2-123*b*(3).

(4) Install bushing (fig. 2-190) in street elbow and install in treadle valve in position shown. Install end of service hose in bushing. Install end of supply hose directly in treadle valve. Secure other ends of hoses in unions (fig. 2-191) at cab left side bulkhead.

2-125. Torque Values for Mounting Hardware

Attaching hardware for air system components are to be torqued to values indicated in table 2-31. Values given are for dry condition. These values apply to mounting screws, bolts, and nuts.

2-126. Air Relay Valves Replacement

a. General. There are four air system relay valves mounted to vehicle frame. Front service relay valve (4, fig. 2-170) is located between axles 1 and 2. Rear service relay valve (6, fig. 2-170) is located on vehicle left side

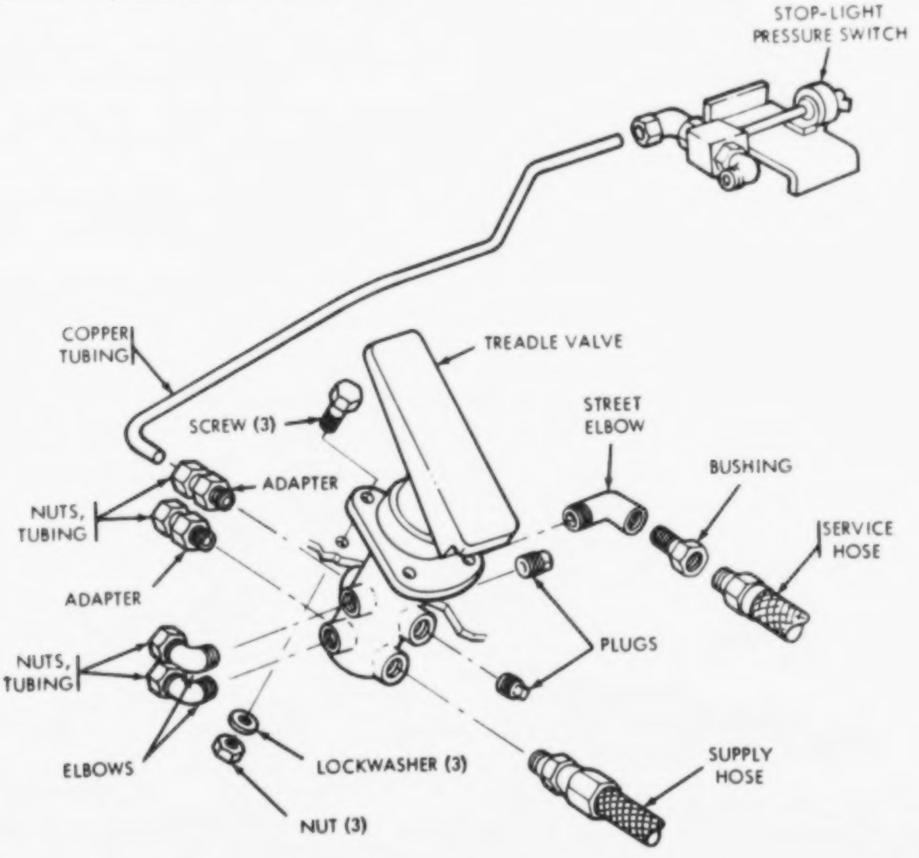

STOP-LIGHT PRESSURE SWITCH
COPPER TUBING
TREADLE VALVE
SCREW (3)
STREET ELBOW
BUSHING
ADAPTER
NUTS, TUBING
SERVICE HOSE
ADAPTER
PLUGS
NUTS, TUBING
ELBOWS
LOCKWASHER (3)
SUPPLY HOSE
NUT (3)
TA027628

Figure 2-190. Brake treadle valve and related parts.

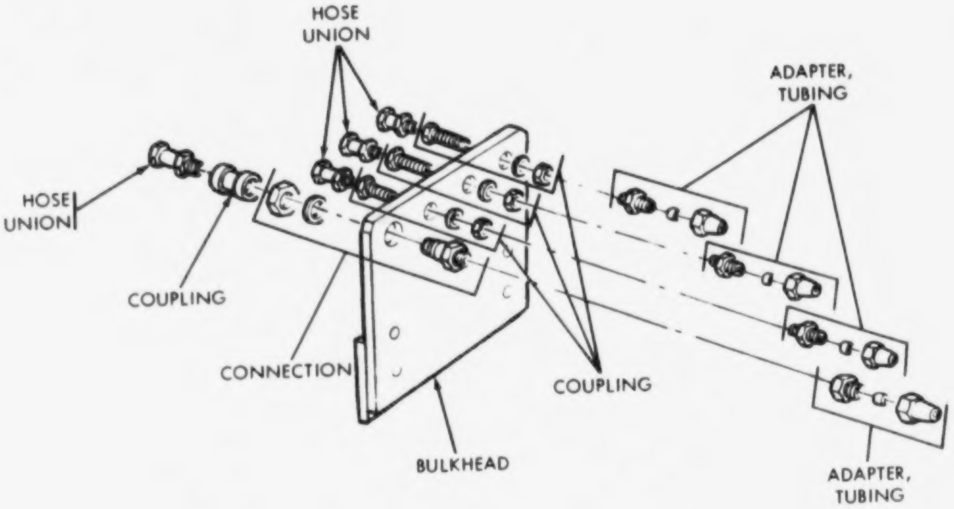

HOSE UNION
ADAPTER, TUBING
HOSE UNION
COUPLING
CONNECTION
COUPLING
BULKHEAD
ADAPTER, TUBING
TA027629

Figure 2-191. Air system fittings at left side bulkhead.

between axles 3 and 4. Trailer service air relay valve (22) is located on vehicle left side above air supply tank. Fail-safe air relay valve is located on vehicle right side between axles 3 and 4. Method of removal and installation of front service relay valve is typical for other valves.

NOTE

Drain air system before servicing air system.

b. Front Service Relay Valve Removal.

(1) Disconnect two hoses (fig. 2-192) from adapters in valves by unscrewing adapter swivel nut from hose end.

(2) Disconnect copper lines from top and bottom elbows.

(3) Remove three nuts, lockwashers, and screws securing valve to frame bracket and remove valve.

(4) If valve requires replacement, remove tank valve, adapters, and elbows from relay valve.

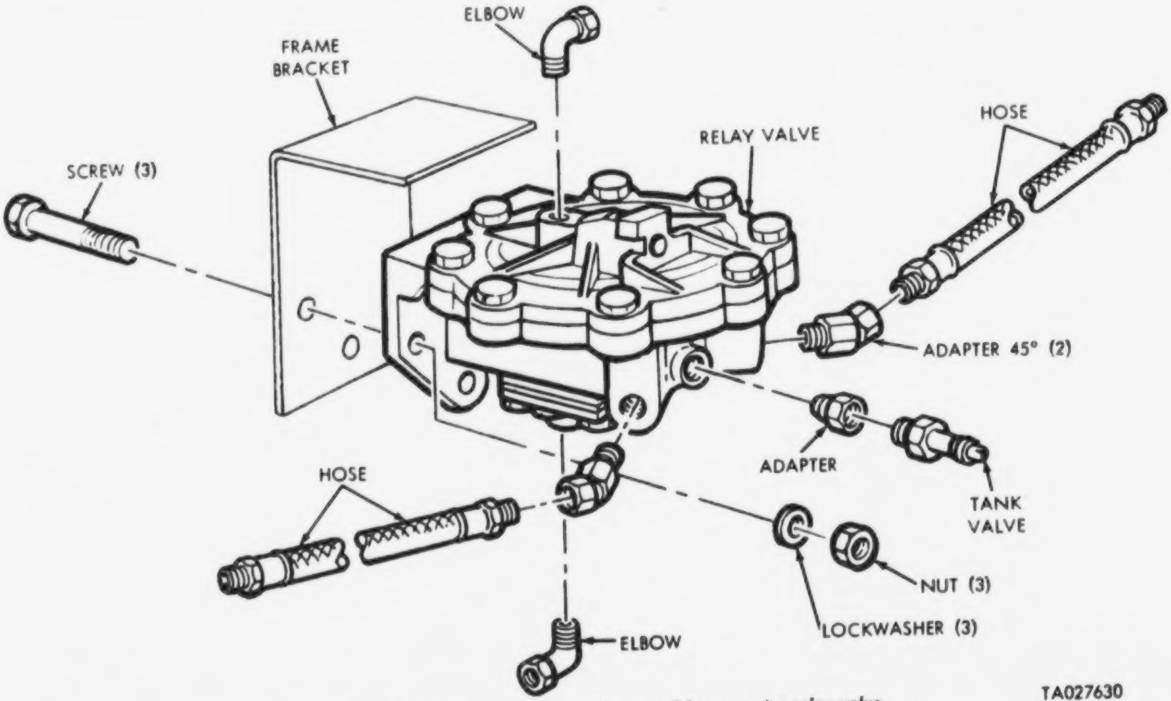

ELBOW
FRAME BRACKET
RELAY VALVE
HOSE
SCREW (3)
ADAPTER 45° (2)
ADAPTER
TANK VALVE
HOSE
NUT (3)
LOCKWASHER (3)
ELBOW
TA027630

Figure 2-192. Removal or installation of front service relay valve.

Table 2-31. *Air System Mounting Hardware Torque Chart*

Bolt or nut size	Torque, dry condition (lb-ft)
1/4 - 20	6 - 8
1/4 - 28	7 - 10
5/16 - 18	
13 - 17	
5/16 - 24	14 - 19
3/8 - 16	23 - 30
3/8 - 16 (GR 8)	35 - 45
3/8 - 24	25 - 35
1/2 - 13	55 - 75
1/2 - 20	65 - 90
1/2 - 20 (GR 8)	90 - 120

c. Front Service Relay Valve Installation.

NOTE

Refer to paragraph 2-123*b*(3), *d*, *e* and *f* for installation information pertaining to the following subparagraphs.

(1) Install elbows (fig. 2-192), adapters and tank valve in relay valve as shown.

(2) Secure relay valve to frame bracket with three screws, lockwashers, and nuts. Torque nuts to 23-30 lb.-ft.

(3) Secure hose ends to 45° adapters by tightening adapter swivel nuts on hose ends.

(4) Connect copper tubes to top and bottom elbows.

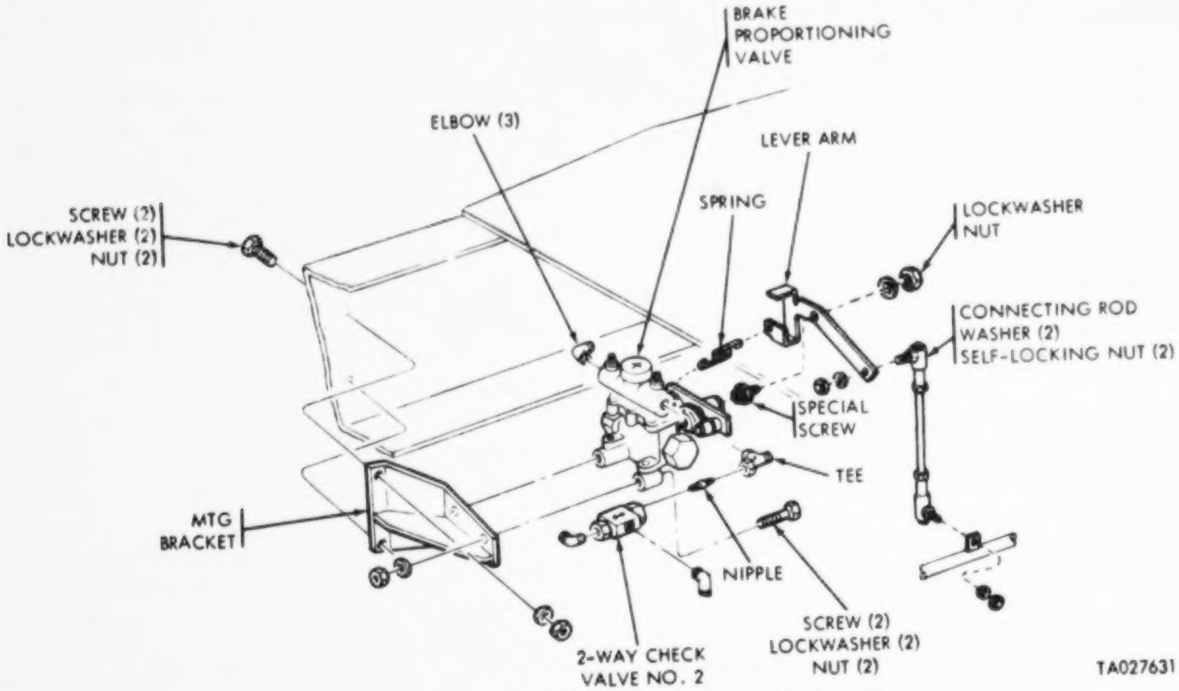

BRAKE
PROPORTIONING
VALVE
ELBOW (3)
LEVER ARM
SPRING
SCREW (2)
LOCKWASHER (2)
NUT (2)
LOCKWASHER
NUT
CONNECTING ROD
WASHER (2)
SELF-LOCKING NUT (2)
SPECIAL
SCREW
TEE
MTG
BRACKET
NIPPLE
SCREW (2)
LOCKWASHER (2)
NUT (2)
2-WAY CHECK
VALVE NO. 2
TA027631

Figure 2-193. Removal or installation of brake proportioning valve.

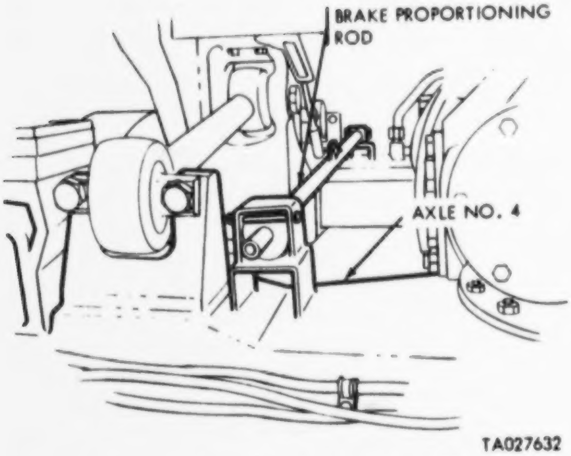

BRAKE PROPORTIONING
ROD
AXLE NO. 4
TA027632

Figure 2-194. Brake proportioning rod on axles 3 and 4.

2-127. Brake Proportioning Valve Replacement

a. General. The brake proportioning valve (fig. 2-193) is located at vehicle left side rear. Brake proportioning valve lever arm is attached to brake proportioning rod (fig. 2-194) mounted to axles 3 and 4.

b. Brake Proportioning Valve Removal.

(1) Disconnect copper lines to three elbows (fig. 2-193) and tee.

(2) Separate connecting rod from lever arm by removing nut and washer from connecting rod end at lever arm.

(3) Remove two nuts, lockwashers, and screws securing brake proportioning valve to mounting bracket and remove valve with attached parts.

(4) Remove spring. Remove nut and lockwasher

securing lever arm to special screw and remove lever arm.

(5) Remove special screw from valve. Remove three elbows and tee with attached fittings from valve ports.

c. Brake Proportioning Valve Installation.

NOTE

Refer to paragraph 2-123*b* (3), *d*, *e*, and *f* for installation information pertaining to the following subparagraphs.

(1) Install tee with attached nipple, check valve, and two elbows in inlet port of proportioning valve. Install remaining elbow in outlet port.

(2) Coat thread surface in valve and thread surface of special screw with suitable thread sealant and install special screw in valve, tightening special screw to 15-20 lb.-ft. torque.

(3) Position lever arm on special screw and secure with lockwasher and nut. Torque nut to 14-19 lb.-ft. Install spring between valve and lever arm.

(4) Position brake proportioning valve with attached parts against mounting bracket and secure with two screws, lockwashers, and nuts. Torque nuts to 23-30 lb.-ft.

(5) Attach connecting rod end to lever arm with washer and selflocking nut. Torque nut to 14-19 lb.-ft. Connecting rod should be 14.19 inches long between attaching stud centerlines.

(6) Attach four copper lines to elbows and tee.

(7) Proper functioning of proportioning valve can be checked by applying 100 psi at inlet port. Output pressure should read 25 ± 5 psi. Adjust length of connecting rod if necessary to obtain proper pressure reading at outlet port with 100 psi air pressure applied at inlet port.

d. Fluid Replacement

(1) Remove the fluid level plug on the linkage side of the valve or the breather plug from the other side of the valve whichever is most accessible.

(2) If the valve is not bolted to a vehicle, position the assembly so that the mounting bolt holes are level.

(3) Fill the valve body with Midland Spec. 2613 fluid to a level even with the bottom of the filler plug hole (fluid level line on casting).

(4) Reinstall the plug and move the linkage arm through its full travel a minimum of three times to work trapped air out of the internal valve mechanism.

(5) Remove the level plug and refill to proper level.

(6) Repeat 4 and 5 until the fluid level remains constant indicating that all the air has been displaced by fluid.

2-128. Air Compressor and Associated Parts

a. General. Air compressor assembly is mounted on engine flywheel housing bracket and is component of diesel engine assembly. Filtered air is fed to compressor from left side air cleaner assembly. Alcohol evaporator and air compressor governor with interconnecting lines are mounted on air compressor.

b. Air Compressor Related Parts Removal.

(1) Drain air system.

(2) Separate air inlet hose (fig. 2-195) by unscrewing union at shutoff cock. Separate air outlet hose by

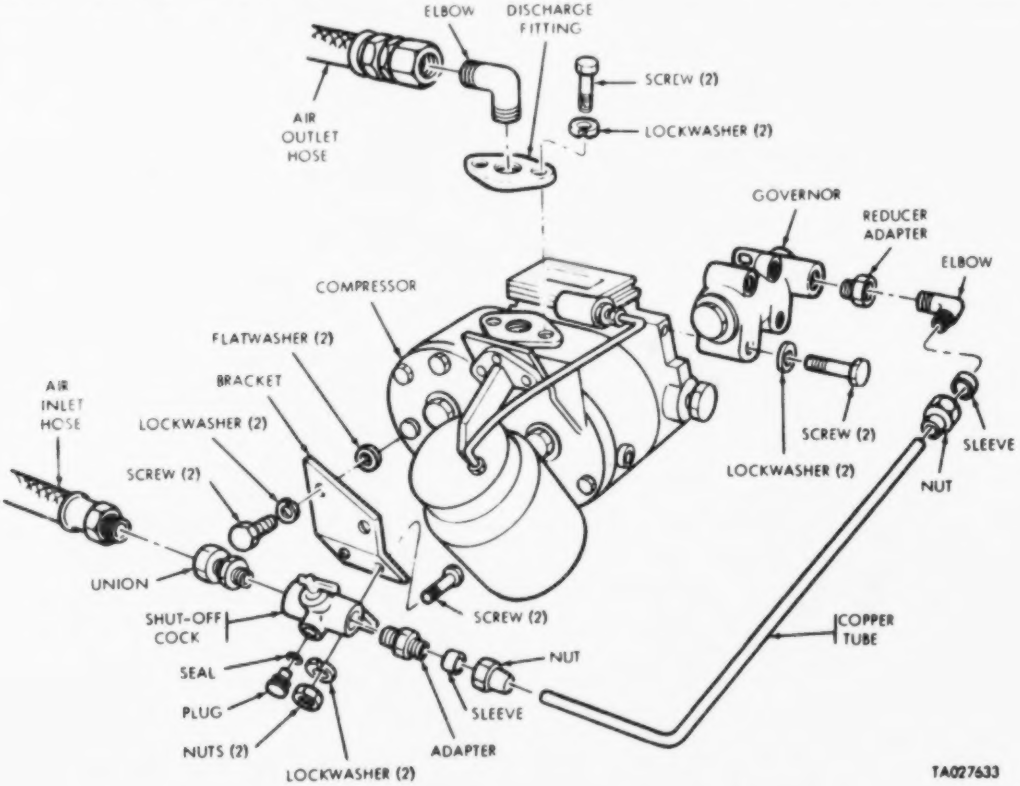


Figure 2-195. Air compressor governor and related parts.

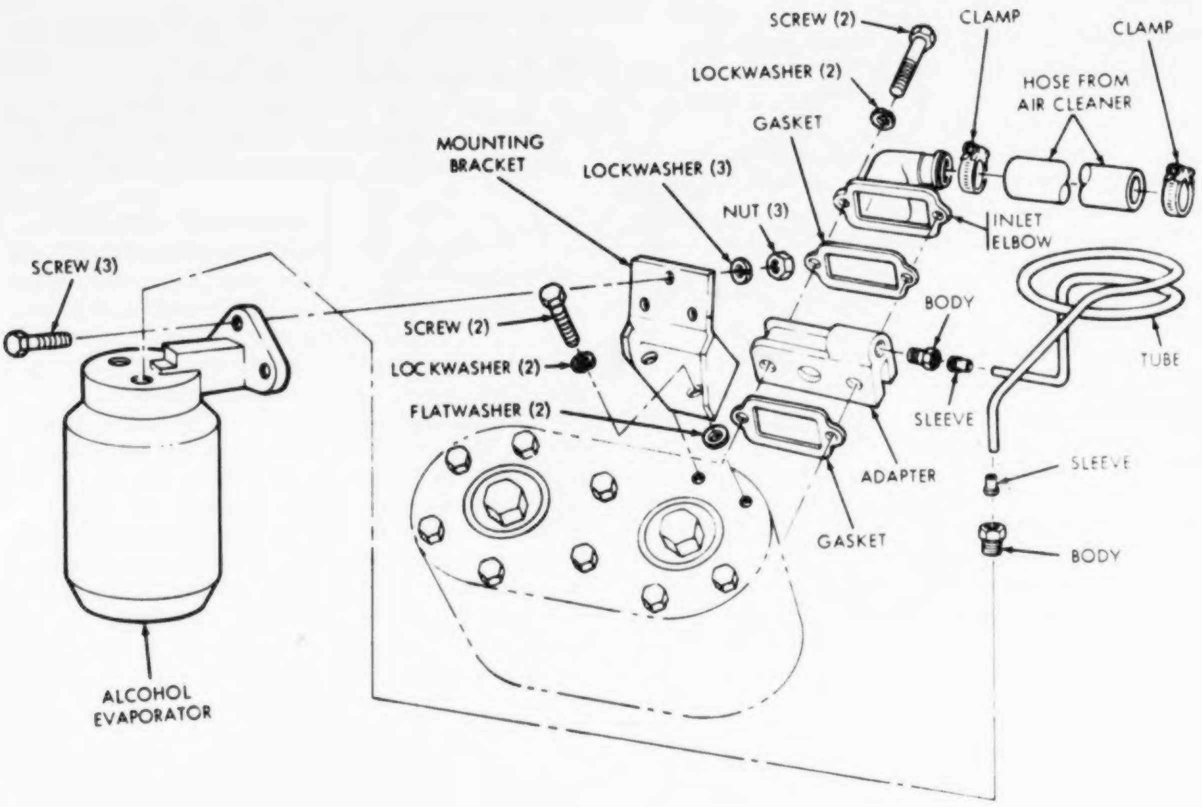


Figure 2-196. Air compressor alcohol evaporator and related parts.

removing hose swivel nut from elbow.

(3) Loosen adjustable hose clamp (fig. 2-196) at elbow and remove hose end and clamp from elbow.

(4) Remove evaporator copper line by unscrewing tube bodies from alcohol evaporator and adapter.

(5) Remove two screws, lockwashers, and flatwashers securing mounting bracket to top of air compressor. Remove mounting bracket with attached alcohol evaporator.

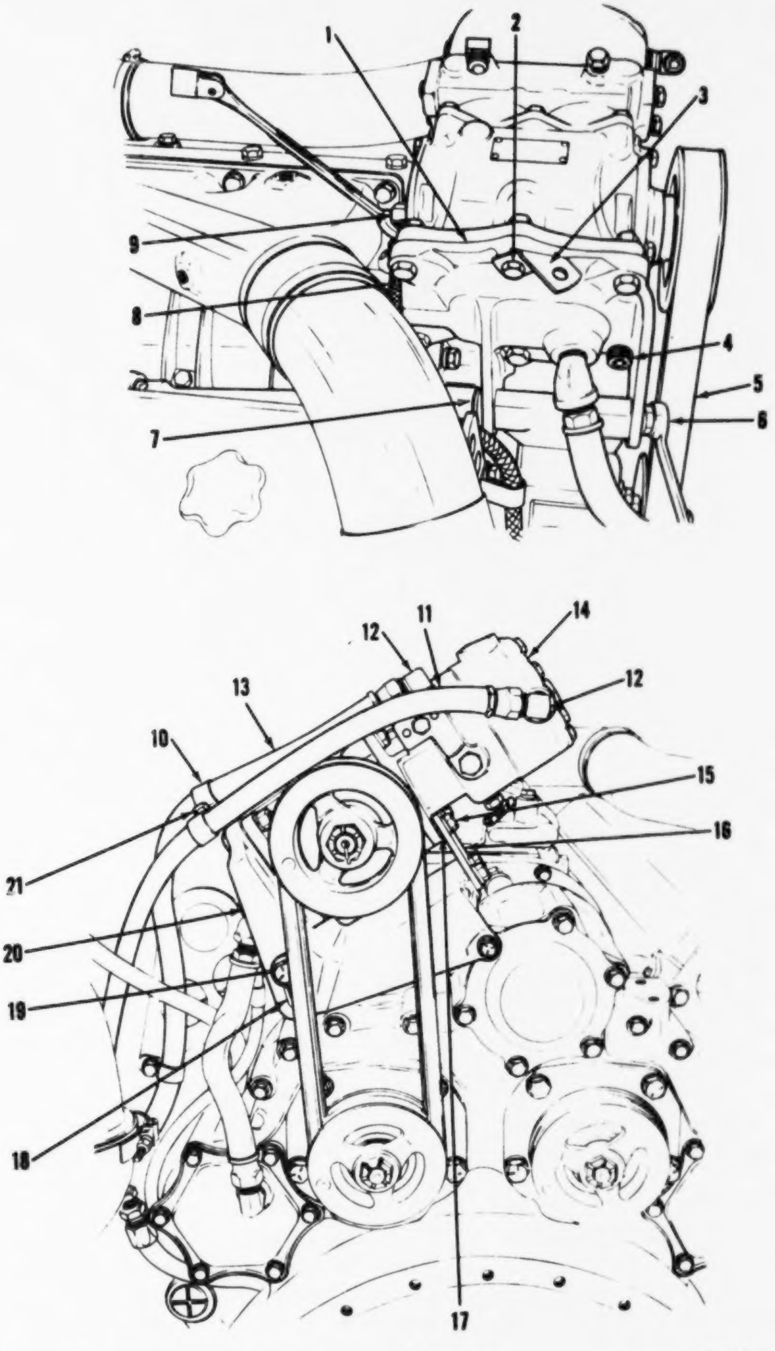
(6) Remove two screws securing inlet elbow to compressor and remove inlet elbow, adapter, and two flat gaskets.

(7) Remove governor copper tube (fig. 2-195) ends from governor and shutoff cock by unscrewing tube nuts from fittings.

(8) Remove two screws and lockwashers securing governor to air compressor and remove governor. Remove two screws, flatwashers, and lockwashers securing mounting bracket to air compressor and remove bracket with attached shutoff cock.

(9) Remove two screws and lockwashers securing discharge fitting with installed elbow and remove discharge fitting.

c. Air Compressor Assembly Removal. Loosen tension at air compressor swivel point (19, fig. 2-197) by turning hexagon nut with socket extension (7) while holding bolt head with wrench (6). Allow air compressor bracket to move down until tension bolt (19) is at top of bracket slot (18), releasing tension on drive belts (5). Remove belt set. Disconnect water inlet (11) and outlet (13) hoses at air compressor by separating swivel fittings from elbows (12). Remove screw, lockwasher, and nut (21) attaching hose clamps (10) to clamp mounting bracket (3). Place crowbar under mounting bracket (17) and pry bracket up for access to swivel end of oil inlet hose (8) at elbow (9) mounted on compressor. Disconnect oil inlet hose from elbow (9). Remove crowbar. Remove hex socket-head screw, lockwasher, and nut (4). Remove five screws, lockwashers, and nuts (2) securing air compressor to mounting bracket. Remove hose clamp mounting bracket (3). Remove two screws and lockwashers (15) and spacers (17) securing air compressor to plate (16). Lift and remove air compressor with attached parts. Remove and discard flat gasket (1) used between air compressor and mounting bracket.



1 Flat gasket
2 Screw, lockwasher, nut (5)
3 Clamp mounting bracket
4 Hexagon socket-head screw, lockwasher, nut
5 Drive belt set
6 Swivel bolt head
7 Socket extension on hexagon nut
8 Oil inlet hose
9 Elbow
10 Hose clamps (2)
11 Water inlet hose
12 Inlet and outlet hose elbows
13 Water outlet hose
14 Air compressor
15 Screw, lockwasher (2)
16 Plate
17 Shim and flat washer (ar)
18 Bracket slot
19 Swivel point tension bolt
20 Bracket, mounting
21 Screw, lockwasher, nut

Figure 2-197. Removal or installation of compressor.

d. Cleaning. If air compressor is to be reused, clean exterior to remove road dirt and grease using suitable cleaning solvent. Determine lube oil and water passages are clear of foreign manner.

e. Inspection and Repair. Repair is limited to replacement of defective air compressor assembly or related parts.

f. Assembly. If air compressor requires replacement, remove pulley, elbows and drain cock from old compressor and install on replacement. Apply suitable sealant to threads of elbows (9 and 12, fig. 2-197) and wipe away any excess before installing in compressor.

g. Air Compressor Assembly Installation.

(1) Position new flat gasket (1, fig. 2-197) on bracket (20). Place air compressor on bracket and secure with one socket-head screw (4), five screws (2), and six lockwashers and nuts. Torque six nuts to 46-50 lb.-ft.

(2) Position same number of shims and flat washers (17) removed and secure plate (16) to air compressor (14) with two screws and lockwashers (15). Two screws (15) replace air compressor screws. Torque replacement screws (15) to 30-35 lb.-ft. If screws cannot be tightened to full depth because of space between air compressor and plate (16), add suitable size and quantity of spacer shims (17).

(3) Secure oil inlet hose (8) to elbow (9). Secure water hoses (11) and (13) to elbows (12).

(4) Position belt set (5) over pulleys. Lift mounting bracket (20) with crowbar to tension belt set so that force of 12 pounds applied at mid-span of belts will deflect belt 7/16 inch, ± 1/16 inch, as shown in figure 2-198. At this point, tighten nut to 71-75 lb.-ft. Secure hose clamps (10, fig. 2-197) to clamp mounting bracket (3) with screw, lockwasher, and nut (21).

h. Air Compressor Related Parts Installation.

NOTE

Mounting hardware installed in following procedures are to be torqued to values outlined in paragraph 2-125. Pipe threads installed are to be teflon tape-wrapped as outlined in paragraph 2-123*f*.

(1) Install elbow (fig. 2-195) in discharge fitting and secure fitting to compressor with two screws and lockwashers.

(2) If shutoff cock is being replaced, install new seal at plug. Secure shutoff cock to mounting bracket with two screws, lockwashers, and nuts. Secure mounting bracket to air compressor with two screws, lockwashers, and flatwashers. Two screws replace air compressor screws.

(3) Position governor against air compressor and secure with two screws and lockwashers. Install copper line as shown. Install union in shutoff cock.

(4) Secure alcohol evaporator (fig. 2-196) to mounting bracket with three screws, lockwashers, and nuts. Secure mounting bracket to air compressor with two screws, lockwashers, and flat washers. Two screws replace screws in air compressor.

(5) Position new flat gaskets, adapter, and inlet elbow on air compressor, as shown, and secure with two screws and lockwashers. Install copper tube as shown. Secure end of air cleaner hose to elbow by tightening adjustable clamp.

(6) Connect air inlet hose (fig. 2-195) to union and air outlet hose to elbow.

i. Air Compressor Governor Adjustment. Remove cover or cap from governor end opposite where hose from reservoir is connected. Loosen locknut on adjusting screw. Run engine at 1500 rpm for 7 minutes to assure buildup of air pressure in system. Keep engine running at 1500 rpm during the remainder of adjustment procedure. Observe reservoir air pressure gage in cab for five minutes to establish interval between governor open-close cycle. Turn adjusting screw clockwise 1-½ turns and observe whether pressure high point of interval has increased or decreased. Turn adjusting screw accordingly to adjust governor high setting between 115 to 120 psi. Tighten locknut and install cover or cap. If, after adjustment, pressure cycle low point is less than 85 to 90 psi, replace governor.

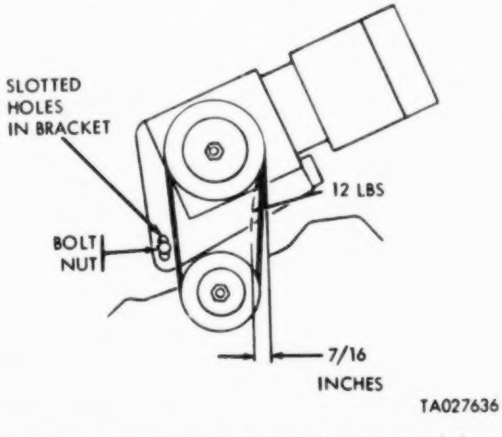


Figure 2-198. Checking and adjusting air compressor belt tension.

Section XXII. WHEELS, TIRES, HUBS, AND DRUMS

2-129. Wheels and Tires

CAUTION

Do not mix radial and bias ply tires on same vehicle.

a. *Removal of Wheel and Spare Wheel and Tire (Fig. 2-199).*

(1) Set parking brake and block vehicle wheels to prevent movement.

(2) Place tubular handles in spare tire carrier. Using two personnel, pull upper retaining pins and lower front of carrier to ground using tubular handles for support. Remove spare tire and wheel.

(3) Using wheel nut wrench, loosen ten cap nuts securing wheel on hub.

NOTE

Studs on left side of vehicle are left-hand threaded, and studs on right side of vehicle are right-hand threaded.

(4) Place jack under axle near wheel to be removed and raise axle until tire is off ground. If axle is being serviced, jack up and block both sides so that axle remains in horizontal position.

(5) Remove ten cap nuts and remove wheel from vehicle.

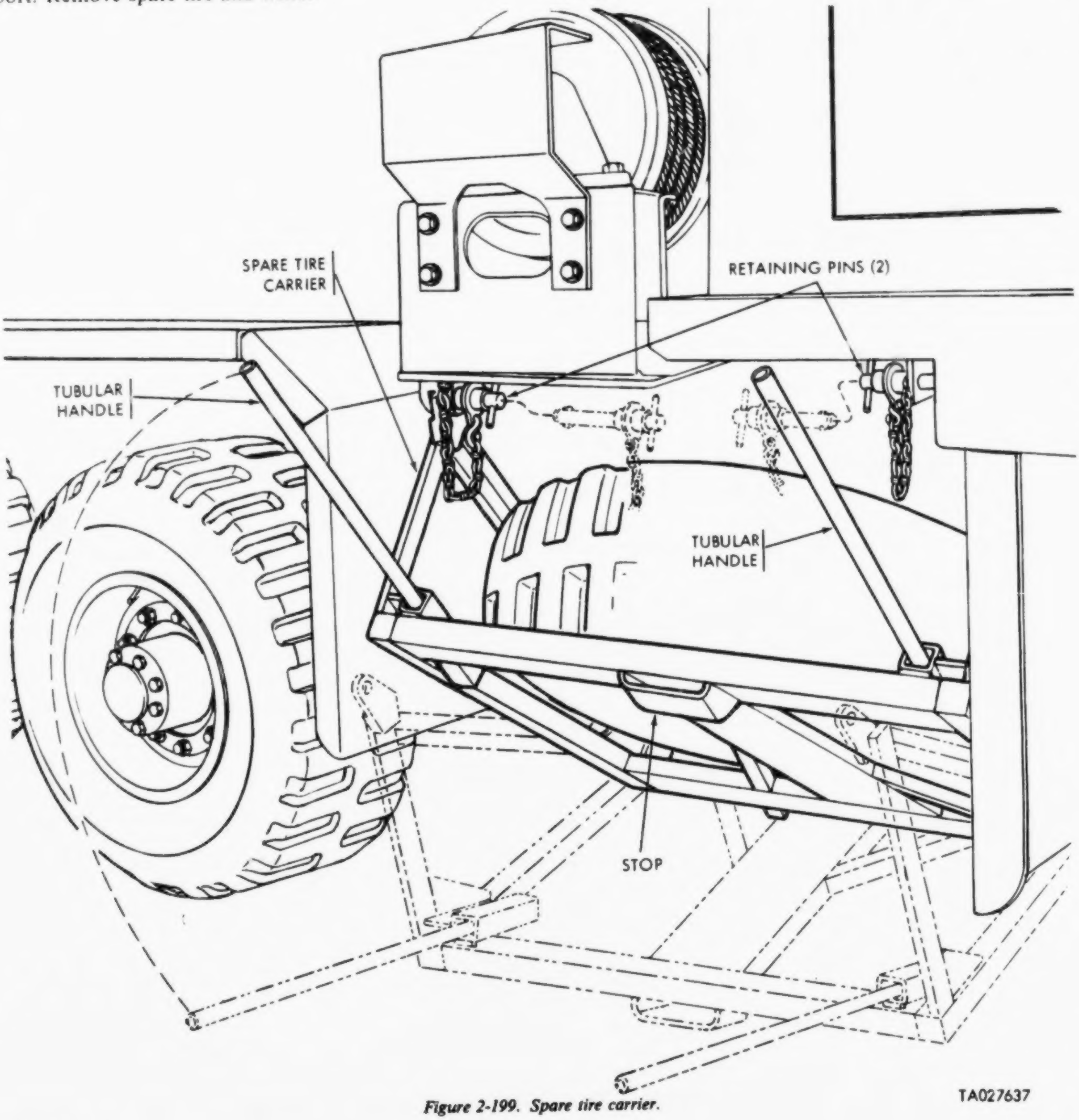


Figure 2-199. Spare tire carrier.

b. Clean Wheel and Repair Tire.

(1) *Cleaning.* Whenever a wheel is removed from its hub, the hub face and mating wheel disc face must be wire brushed to bare metal before the wheel is remounted. In addition, the wheel studs, capnuts, and wheel ballseats must be clean and undamaged. Any worn capnuts or damaged studs must be replaced. If mounting face of wheel is not flat or ballseats are damaged, wheel is not to be put in service. NO OIL OR GREASE IS ALLOWABLE ON CAPNUTS, STUDS, OR BALLSEATS OF WHEEL.

NOTE

Clean preservative from new wheel mounting face using dry cleaning solvent, FED SPEC P-D-680.

NOTE

Refer to *d* and *e* below for replacing tire on wheel.

(2) *Repairing.* Repair tires using Tubeless Tire Repair Kit P/N M100 (17705).

c. Installation of Wheel (fig. 2-200).

(1) With axle raised, position wheel on studs.

(2) Install 10 capnuts on studs using finger pressure, then tighten nuts using suitable wrench and wrench socket until nuts rest against wheelplate and wheel rests against hub.

(3) Torque tighten nuts following sequence shown in figure 2-200. Use torque multiplier with socket, socket extension, and torque wrench to tighten capnuts to 650-750 lb.-ft. torque.

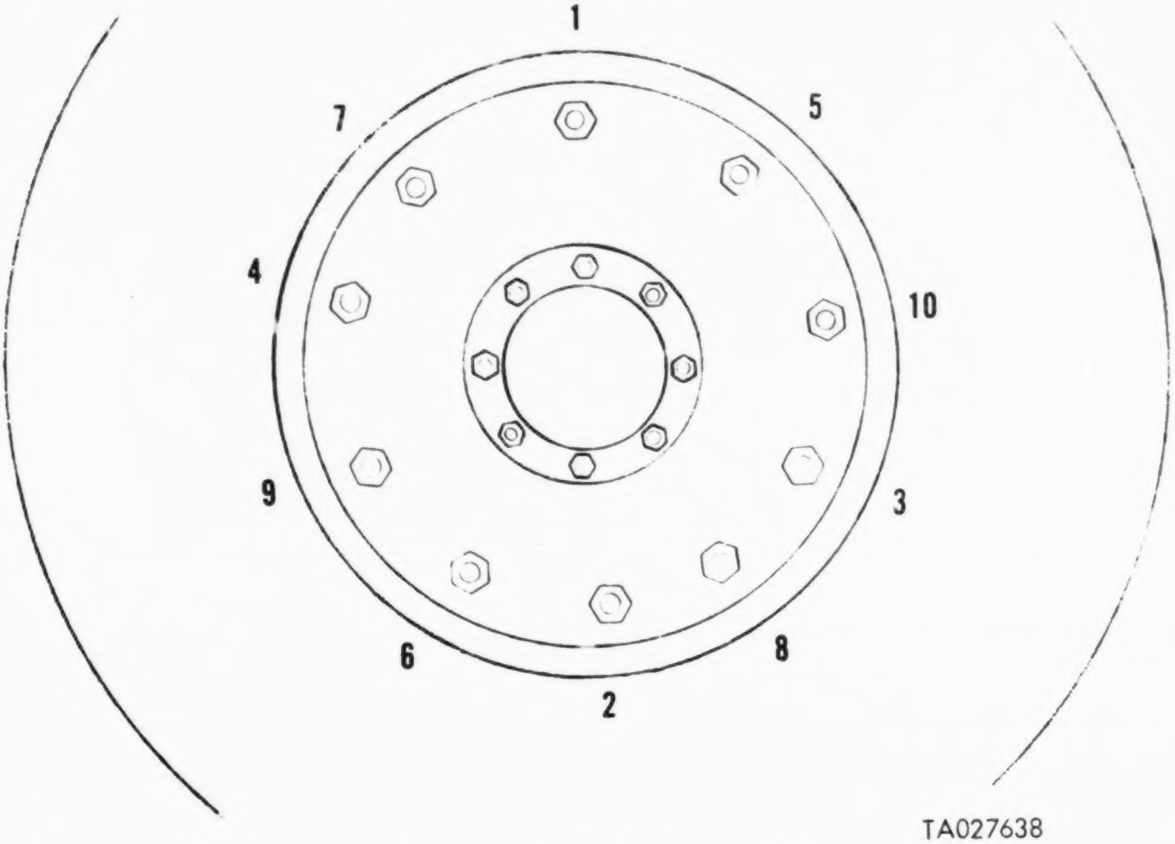


Figure 2-200. Torque tightening sequence for wheel nuts.

d. Retorqueing Wheel Nuts. After approximately 25 to 50 miles of vehicle operation, the capnuts must be checked and retightened as required using a torque wrench. Each cap nut should be checked for the specified 650-750 lb.-ft. torque.

e. Removal of Tire from Wheel (Figs. 2-201 through 2-203).

(1) Deflate tire completely by removing valve core.

(2) Pour soapy water around circumference of bead. Use soapy water liberally to thoroughly soak bead and rim.

WARNING

Do not attempt to remove tire until tire has been completely deflated.

(3) With flat end of tire iron, T45, placed between tire and rim flange, straighten tire iron to a vertical position and hammer downward on the knob of the tire iron until the knob rests against the rim's edge (A, fig. 2-201). To break first bead loose from rim, apply downward pressure on tire iron, T45. Insert iron block (approximately 1-½ x 1½ x 7 inches) or screw clamp between

tire and rim to maintain this break. Tap tire iron with hammer around circumference of bead until the first bead is completely freed from the rim (B, fig. 2-201).

(4) Turn tire over and repeat (2) and (3) above to free second bead from rim.

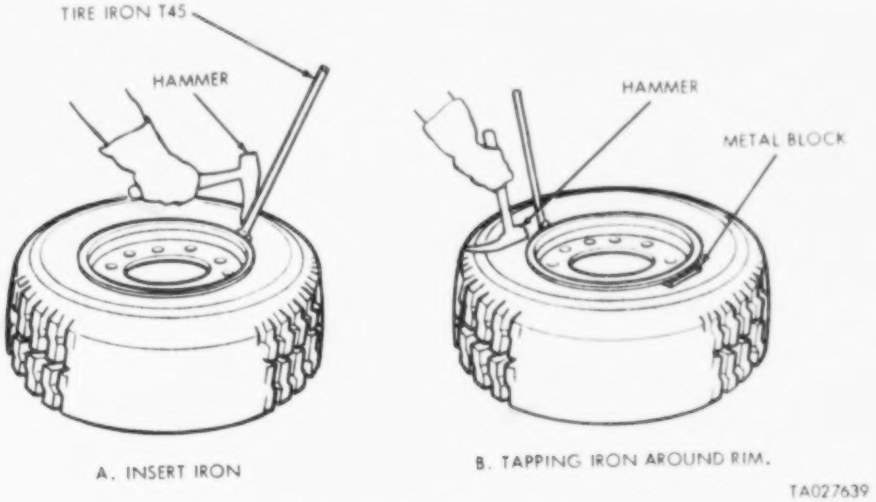
NOTE

After tire is completely free from rim, lubricate bead area with soapy water solution.

(5) Insert curved ends of tire iron, T45, tire iron combination of T46C and T46B, and the straight end of tire iron (common tool set) between bead and rim about four to six inches apart. Lift first bead over flange (A, fig. 2-202).

(6) Remove tire irons T45 and T46B. Tire iron T46C will remain in place to hold bead over flange (B, fig. 2-202). Insert the curved end of common tire iron progressively between the bead and rim, taking small bites each time until about halfway around the rim (C, fig. 2-202). Insert a metal block to help keep the bead separated from the flange (D, fig. 2-202). Continue the operation with common tire iron until the first bead is free from the rim (E, fig. 2-202).

(7) Remove second bead of tire from rim by inserting the straight ends of common tire iron under the rim (A, fig. 2-203). Apply a downward pressure and force a portion of the flange over the bead (B, fig. 2-203). Thoroughly lubricate the tire bead and rim flange with soapy water solution. Use a hammer to move the tire irons apart (C, fig. 2-203). Again apply downward pressure and force the flange over the bead (D, fig. 2-203). Repeat this operation until the rim is forced from the tire.



A. INSERT IRON

B. TAPPING IRON AROUND RIM.

TA027639

Figure 2-201. Breaking the tire bead.

f. Installation of Tire on Wheel (Figs. 2-204 and 2-205).

CAUTION

The steel band used to keep new tire beads expanded during shipment is to be cut and removed before mounting the tire on a wheel. The cutting of such a band on a mounted tire containing even low presure is very dangerous to personnel.

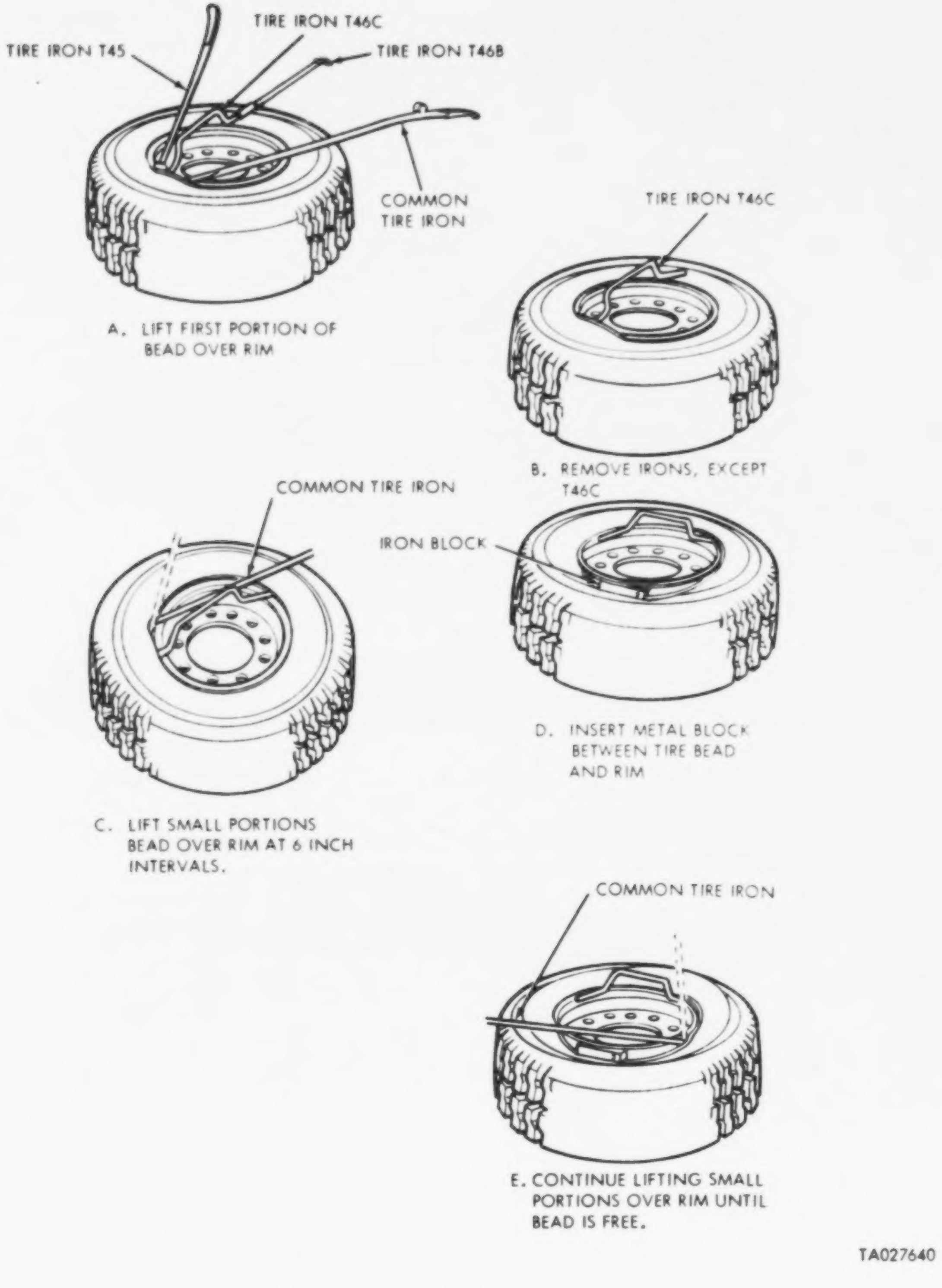
NOTE

Inspect rim to be sure bead seats are clean and smooth. Inspect wheel mounting faces and ball-seats for damage (see *d* below).

(1) Lay rim down with mounting flange up. Install valve by inserting valve from inside rim through valve hole and screwing it in place. Lubricate the first bead and position tire over tip of rim. Push a portion of the first bead over rim (A, fig. 2-204). Use a wood two-by-four about one foot long and hammer the first bead around the rim and under the flange (B, fig. 2-204).

(2) Insert straight ends of tire irons, T45, T46B, and common tire iron with common tire iron in the middle. Place these tire irons between tire and rim, four to eight inches apart. Force second bead under edge of flange by pushing down on tire iron (A, fig. 2-205). Remove tire iron. Tire iron T46B must remain in place to hold second bead under flange (B, fig. 2-205). Place curved end of tire iron T45 between head and rim flange with knob toward rim. Insert curved end of common tire iron to hold bead under flange. Push common tire iron out and downward to force second bead under flange (C, fig. 2-205). Insert common tire iron in place of tire iron T45. Position tire iron T45 four to eight inches away and take another bite (D, fig. 2-205). Continue the operation until halfway around rim. Insert a metal block between the tire and rim to hold bead under flange. Continue moving tire iron T45 and common tire iron around rim until the tire bead is completely secured by the rim flange.

(3) Inflate tire to required pressure of 75 psi front and 90 psi rear for bias ply tires; 70 psi front and 100 psi rear for radial ply tires.


TIRE IRON T46C
TIRE IRON T45
TIRE IRON T46B
COMMON TIRE IRON
TIRE IRON T46C
COMMON TIRE IRON
IRON BLOCK
COMMON TIRE IRON

A. LIFT FIRST PORTION OF BEAD OVER RIM

B. REMOVE IRONS, EXCEPT T46C

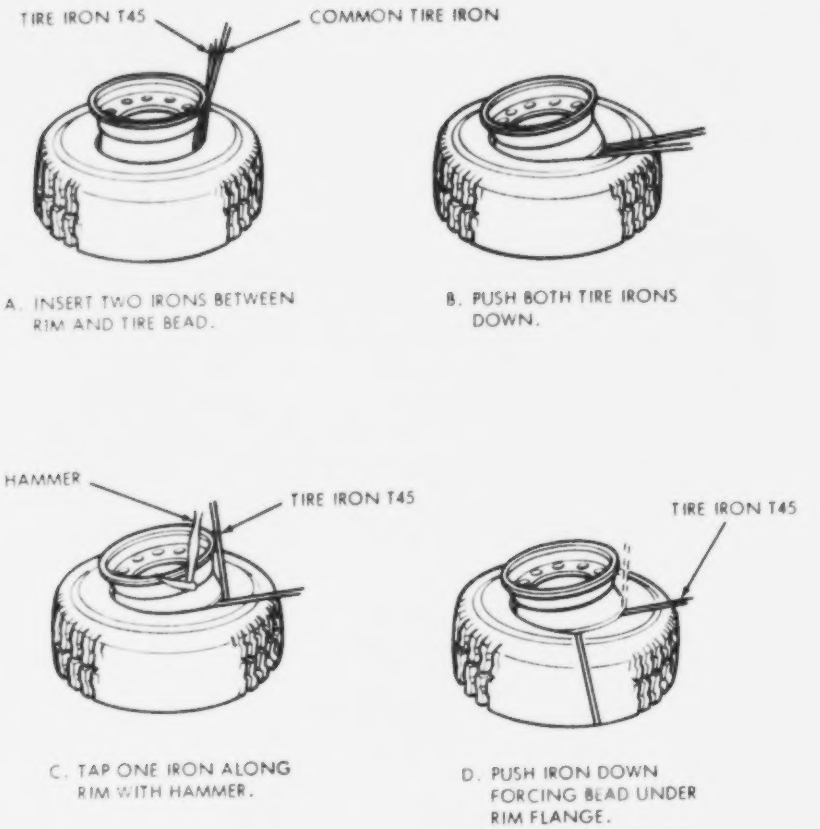
C. LIFT SMALL PORTIONS BEAD OVER RIM AT 6 INCH INTERVALS.

D. INSERT METAL BLOCK BETWEEN TIRE BEAD AND RIM

E. CONTINUE LIFTING SMALL PORTIONS OVER RIM UNTIL BEAD IS FREE.

TA027640

Figure 2-202. Using tire irons to lift first bead over rim.


TIRE IRON T45
COMMON TIRE IRON
HAMMER
TIRE IRON T45
TIRE IRON T45
TA027641

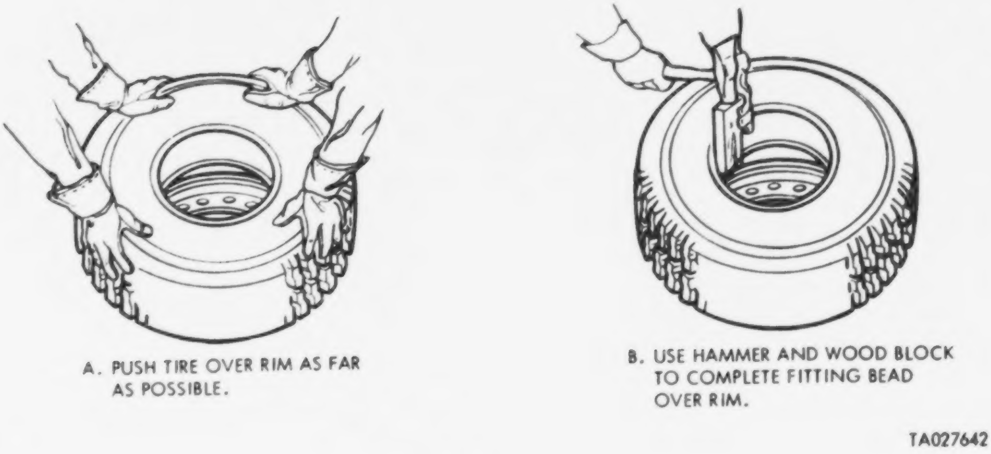
A. INSERT TWO IRONS BETWEEN RIM AND TIRE BEAD.

B. PUSH BOTH TIRE IRONS DOWN.

C. TAP ONE IRON ALONG RIM WITH HAMMER.

D. PUSH IRON DOWN FORCING BEAD UNDER RIM FLANGE.

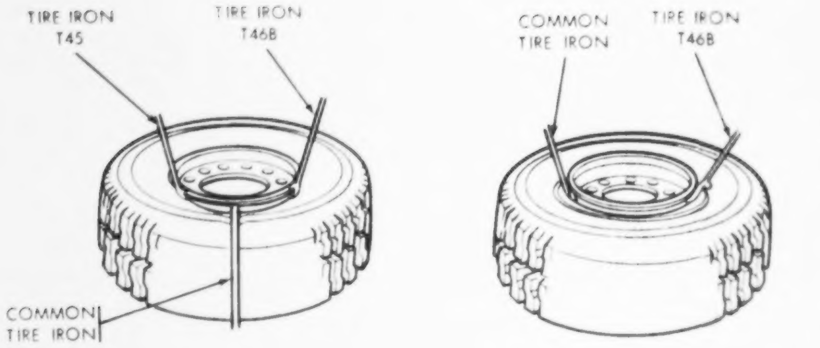
Figure 2-203. Using tire irons and hammer to lift second bead over rim.



A. PUSH TIRE OVER RIM AS FAR AS POSSIBLE.

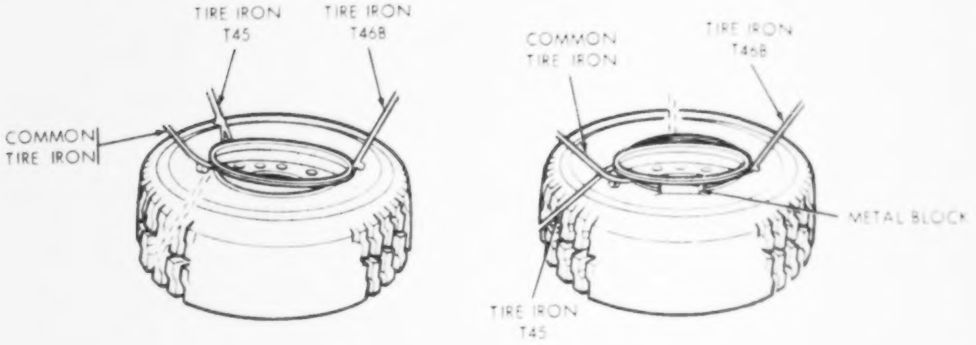
B. USE HAMMER AND WOOD BLOCK TO COMPLETE FITTING BEAD OVER RIM.

Figure 2-204. Installation of tire on wheel — fitting first bead over rim.



A. PUSH FIRST PORTION OF BEAD BELOW RIM FLANGE.

B. REPLACE IRON T45 WITH COMMON TIRE IRON WHILE HOLDING BEAD DOWN WITH IRON T46B.



C. PUSH SECOND SMALL PORTION OF BEAD BELOW RIM FLANGE.

D. AGAIN REPLACE IRON T45 WITH COMMON TIRE IRON AND PUSH SMALL PORTION OF BEAD BELOW RIM FLANGE.

TA027643

Figure 2-205. Installation of tire on wheel — fitting second bead over rim.

g. Tire Rotation. Semiannually, rotate and match tires according to degree of wear.

2-130. Front Axle Hubs and Drums

NOTE

It is not necessary to remove wheels from hub assembly for normal scheduled maintenance.

a. Removal of Hub and Drum Assembly (fig. 2-206).

(1) With wheels removed, remove two screws (18), lockwashers (17), shaft stop washer (16), and spacer (15).

(2) Remove eight nuts (19) and lockwashers (20) from drive flange (13). Pull drive flange from axle shaft with gasket (12). Unless damaged, leave snapring (14) and preformed packing (21) in place on drive flange.

(3) Bend tab on lockwasher (10) off of jamnut (11) and remove jamnut (11) using wrench socket CPR102292-2. Remove lockwasher (10) and pierced washer (9). Using wrench socket CPR102292-2, remove adjusting nut (8).

(4) Carefully remove hub and drum assembly from spindle. Remove outer bearing cone (6) to avoid droping it when assembly is pulled. The inner bearing cone may be removed by hand after hub and drum assembly is pulled.

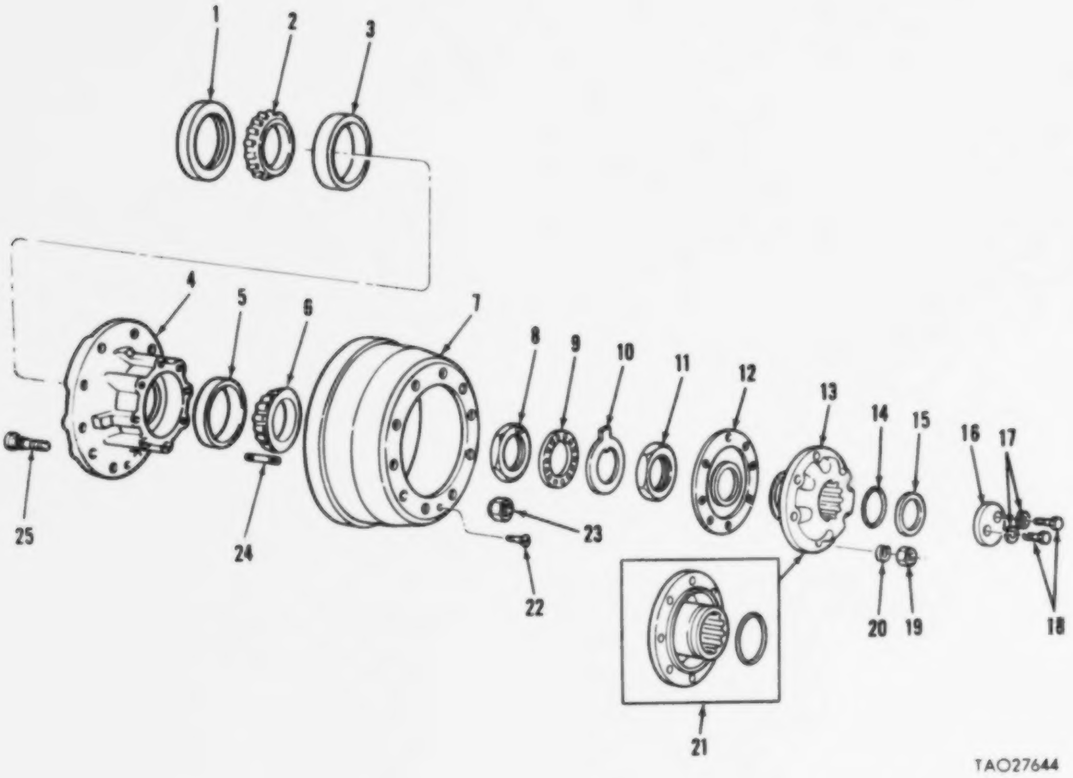
b. Disassembly of Hub Assembly.

NOTE

Drum need not be removed from hub for scheduled maintenance. If removal is required, refer to *c* below.

(1) Remove inner oil seal (1) only if damaged or worn. Remove by tapping through hub bore, using hammer and appropriate size drift-pin.

(2) Do not remove bearing cups (3 and 5) unless they are damaged. Remove worn or damaged bearing cups by applying drift-pin through hub to cup inner



1 Oil seal, inner
2 Cone, bearing, inner
3 Cup, bearing, inner
4 Hub
5 Cup, bearing, outer
6 Cone, bearing, outer
7 Drum, brake
8 Nut, adjusting
9 Pierced washer
10 Lockwasher
11 Nut, jam
12 Gasket
13 Drive flange
14 Snapring
15 Spacer
16 Washer, shaft stop
17 Lockwasher (2)
18 Screw (2)
19 Nut (8)
20 Lockwasher (8)
21 Packing, preformed
22 Screw (5)
23 Nut (10)
24 Stud (8)
25 Wheel stud (10)

Figure 2-206. Front axle hub and drum assembly — exploded view.

face and tapping with hammer.

c. *Removal of Drum.* Remove five screws (22) securing drum to hub. If required, use puller with special screw holes (placed 180° apart) to remove drum, or push drum off by turning capscrew in holes against hub.

NOTE

If brakes are to be serviced, refer to paragraph 2-118.

d. *Inspection of Components.*

(1) Inspect i. d. surfaces of wheel bearing for nicks and burs. Inspect bearing cups for scoring or other damage.

(2) If oil seal (1) remains in hub, wipe off with kerosene and reinspect for damage or wear. Replace if required.

(3) Inspect seating of wheel stud caps on hub inner face. Check stud seating with 0.003 to 0.005 feeler gage to assure that there is no clearance between stud cap and hub. If drum is removed, try moving each wheel stud by hand in hub holes. If wheel stud(s) is/are loose in hub hole, replace hub assembly and notify support personnel for stud replacement in old hub.

(4) Inspect brake drum for scoring. Replace, if necessary, or notify direct support personnel for minor refacing.

(5) Inspect drive flange splines for damage. Inspect gasket (12) for corrosive damage or tears. Inspect stop washer (16) and preformed packing (21) for damage or wear.

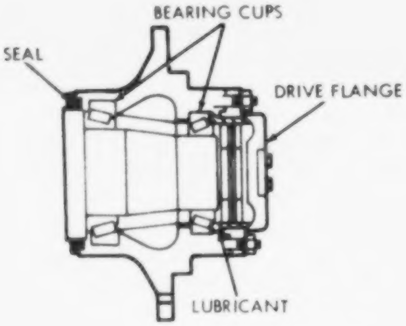
e. *Cleaning and Lubrication of Hub Assembly (Fig. 2-207).*

(1) Clean all old grease from wheel hub, bearing cones, and hub cap using dry-cleaning solvent and stiff fiber brush. Refer to TM 9-214 for inspection, care, and maintenance of bearings.

CAUTION

Do not clean these parts with gasoline, nor in a hot solution, nor with water and alkaline solution.

(2) Pack clean bearings so that grease is forced into the cavities between rollers and cage from large end of cone.



TA027645

Figure 2-207. Lubricating hub assembly.

f. Assembly of Hub Assembly (figs. 2-208 and 2-209).

(1) Install inner bearing cup, using driver CPR-109755-1 with handle 7950113 (A, fig. 2-208). Tap replacer so that even pressure is applied to inner bearing cup until cup bottoms. Use driver CPR109755-2 with handle 7950113 to install outer bearing cup (B, fig. 2-208).

(2) With hub in upright position, install inner wheel bearing cone. Position oil seal on hub and hand press lightly into hub (fig. 2-209). Position replacer CPR102294 with handle 7950113 to pilot bearing i. d., and tap oil seal flange seats on face of hub inner rim.

NOTE

Do not bang on replacer after seal has bottomed.

g. Installation of Drum. Position drum on hub taking care not to damage wheel studs, and tap drum firmly against hub. Install five screws. (22, fig. 2-206).

h. Wheel Bearing Adjustment and Installation of Hub and Drum Assembly.

(1) Position hub and drum assembly on spindle. If drum binds on brake shoes when partially installed over shoes, turn each of two adjusting bolt starwheels to reduce brake shoe spread. (A momentary application of brakes may seat the actuators and also retract the shoes enough to allow drum to be installed.) Install outer wheel bearing after hub and drum assembly is positioned on spindle.

(2) Refer to figure 2-206 and install wheel bearing adjusting nut (8) against outer wheel bearing using wrench socket CPR102292-2. Provide for sufficient clearance between brake shoe and drum so that drag will not interfere with bearing adjustment.

(3) Tighten nut to 200 lb.-ft. torque while hub is being rotated. Rotate hub in both directions to correctly position bearings.

(4) Back off adjusting nut 1/4 to 1/3 turn.

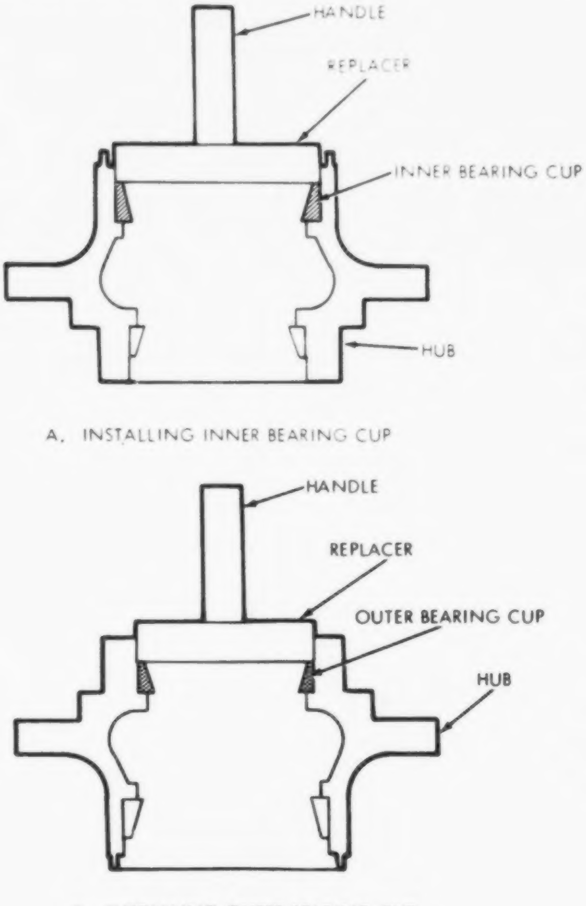
(5) Assemble pierced washer, lockwasher, and jamnut. Use wrench socket CPR102292-2 to tighten jamnut between 250 and 400 lb.-ft. torque.

(6) Bend lockwasher over nut (on No. 1 and No. 2 axle only).

(7) Clean face of hub and apply light coat of grease to drive flange gasket (12). Position gasket. Position drive flange (13) over hub studs and gasket. Install eight lockwashers (20) and nuts (19). Tighten nuts to 185-235 lb.-ft. torque.

(8) Install feeler gage between drum and brake lining through slot in dust shield. If clearance is more than 0.060 inch, adjust brakes manually to achieve required 0.040 to 0.060 inch clearance (para 2-115).

(9) Install spacer (15), and shaft stop washer (16) in drive flange by securing two screws (18) with lockwashers (17) into axle shaft end holes. Tighten screws to 21-27 lb.-ft. torque.



A. INSTALLING INNER BEARING CUP

B. INSTALLING OUTER BEARING CUP

TA027646

Figure 2-208. Using drivers CPR109755-1 and -2 to install wheel bearing cups on front hubs.

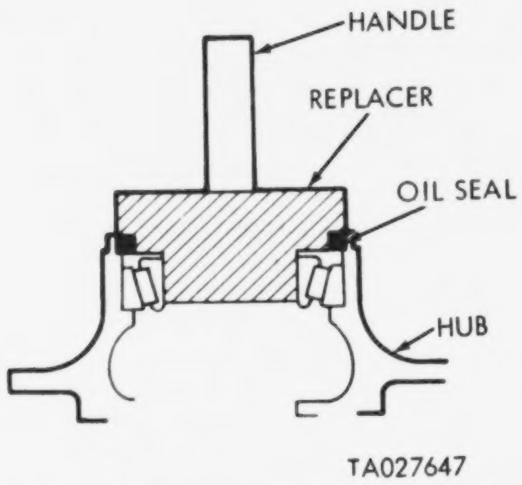


Figure 2-209. Using replacer CPR102294 to install hub oil seal.

2-131. Rear Axle Hubs and Drums

NOTE

It is not necessary to remove wheels from hub assembly for normal scheduled maintenance.

a. Removal of Hub and Drum Assembly (fig. 2-210).

NOTE

Unless parking brake is applied with air system charged above 65 psi, compress fail-safe units manually to release brake shoes from drum contact.

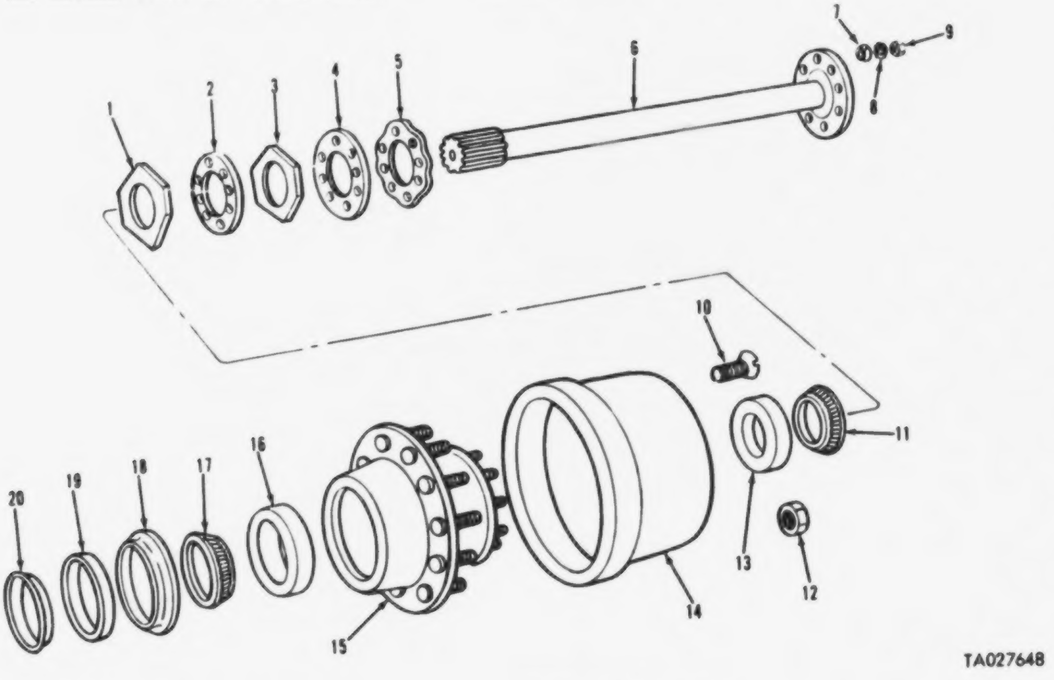
(1) With wheel removed, remove eight nuts (9) and washers (8) from hub cap. Use 10-lb sledge and strike bossed area at center of cap with force until conical dowels (7) loosen or pop out of their seats. Drive screwdriver point into slots on dowels to widen i. d. and pull dowels off studs with pliers.

(2) Pry hub cap away from hub so that cap can be gripped. Pull cap and shaft assembly (6) from axle.

(3) Remove outer oil seal (4).

(4) Using wrench socket CPR102292-2, remove wheel bearing jamnut (3). Remove pierced washer (2) and, using wrench socket CPR102292-2, remove adjusting nut (1).

(5) Pull hub and drum outward on spindle to free outer bearing cone (11). Remove hub and drum assembly from vehicle.



1 Adjusting nut
2 Pierced washer
3 Jamnut
4 Oil seal, outer
5 Gasket
6 Drive shaft
7 Dowel, conical (8)
8 Washer, toothed (8)
9 Nut (8)
10 Screw (5)
11 Cone, bearing, outer
12 Cap nut (10)
13 Cup, bearing, outer
14 Drum
15 Hub and oil slinger assembly
16 Cup, bearing, inner
17 Cone, bearing, inner
18 Oil seal, inner
19 Seal wiper and spacer assembly
20 Wiper, spindle front

Figure 2-210. Rear axle hub and drum assembly — exploded view.

b. Disassembly of Hub and Drum Assembly (fig. 2-210).

NOTE

It is unnecessary to remove drum for scheduled maintenance.

(1) Remove inner oil seal (18) by applying drift-pin o inner bearing cone inside face (through the hub) and tapping with hammer.

(2) Do not remove outer bearing cup (13) and inner bearing cup (16) unless they are damaged. Remove worn or damaged bearing cups by applying drift-pin through hub to cup inner face and tapping with hammer.

c. Removal of Drum. Remove five screws (10) securing drum to hub. If required, use puller with special screw holes (placed 180° apart to remove drum, or push drum off by turning capscrew in holes against hub.

d. Inspection of Components.

(1) Inspect inner diameter of wheel bearings for nicks and burs. Inspect bearing cups for scoring or other damage.

(2) Inspect oil seals (4 and 18) and seal wiper (19) for damage or wear.

(3) Inspect wheel stud caps for tight seating.

(4) Inspect brake drum for scoring. Replace, if necessary, or notify direct support personnel for minor refacing.

(5) Inspect drive shaft splines for damage. Inspect gasket (5) for corrosive damage or tears. Inspect wiper (20) for distortion or scoring.

e. Cleaning and Lubrication of Hub Assembly (fig. 2-211).

(1) Clean all old grease from wheel hub, bearing cones, and shaft and cap assembly using dry-cleaning solvent and stiff fiber brush. Refer to TM 9-214 for inspection, care, and maintenance of bearings.

CAUTION

Do not clean these parts with gasoline, nor in a hot solution, nor with water and alkaline solution.

(2) Pack cleaned bearings so that grease is forced into the cavities between rollers and cage from large end of cone.

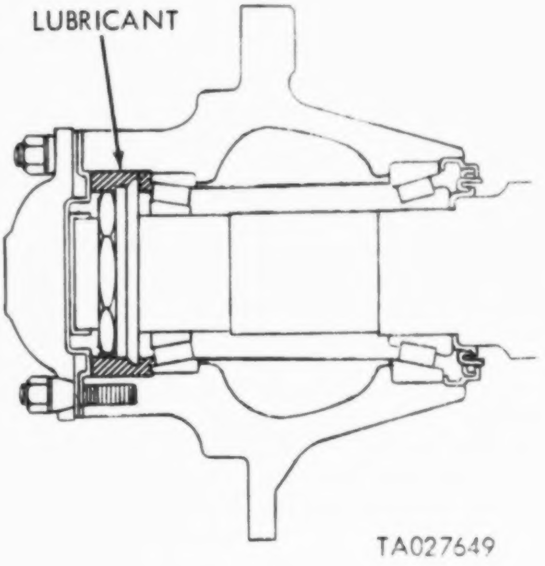
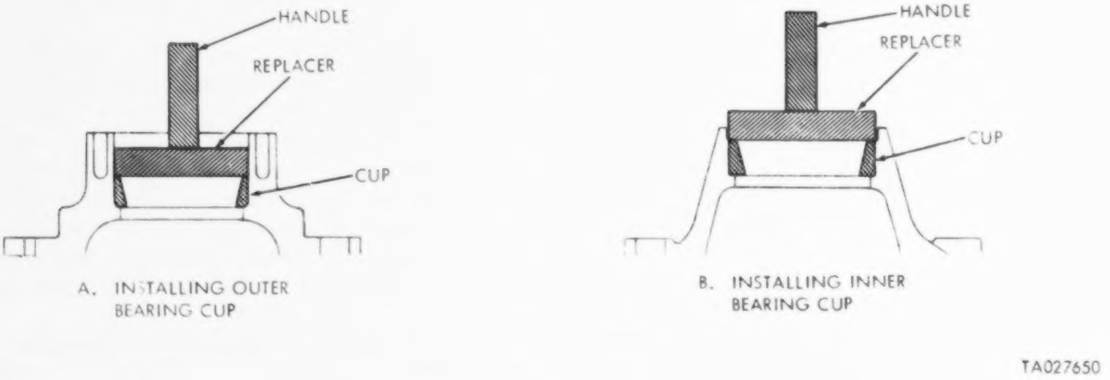


Figure 2-211. Lubricating hub assembly — rear axle



A. INSTALLING OUTER BEARING CUP

B. INSTALLING INNER BEARING CUP

Figure 2-212. Using drivers CPR109755-2 and -3 to install wheel bearing cups in rear axle hub.

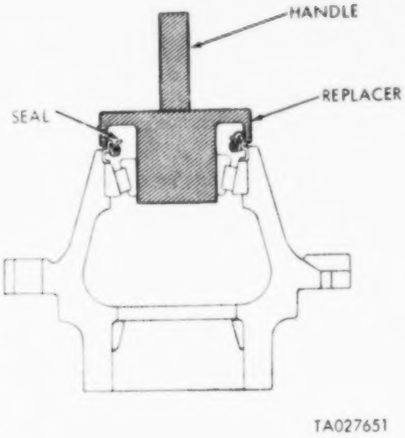


Figure 2-213. Using replacer CPR102298 to install inner oil seal on rear axle hub.

f. Assembly of Hub Assembly (figs. 2-200 and 2-201).

(1) Install inner bearing cup, using driver CPR109755-2 with handle 7950113 (B, fig. 2-200). Tap replacer so that even pressure is applied to inner bearing cup until cup bottoms. Use driver CPR109755-3 with handle 7950113 to install outer bearing cup (A, fig. 2-212).

(2) With hub in upright position, install inner wheel bearing cone. Position oil seal on hub and hand press lightly into hub inner diameter (fig. 2-201). Position replacer CPR102298 with handle over bearing outside diameter and tap replacer seats on face of hub inner rim.

g. Installation of Drum. Position drum on hub taking care not to damage wheel studs. Tap drum firmly against hub. Install five screws (8) (fig. 2-198).

h. Replacement of Wiper and Spacer Assembly and/or Outer Oil Seal (fig. 2-214).

(1) Pry or tap worn or damaged inner wiper and spacer assembly or outer seal from spindle.

(2) Use driver CPR102296 to install new outer spindle oil seal (B, fig. 2-214).

(3) Use driver CPR102297 to install new wiper and spacer assembly (A, fig. 2-214).

i. Adjustment of Wheel Bearing and Installation of Hub and Drum Assembly.

(1) Position hub and drum assembly on spindle. If drum binds on brake shoes when partially installed over shoes, turn each of two adjusting bolt starwheels to reduce brake shoe spread. (A momentary application of brakes may seat the actuators and also retract the shoes enough to allow drum to be installed. Install outer wheel bearing cone after hub and drum assembly is positioned on spindle.

(2) Refer to figure 2-210 and install wheel bearing adjusting nut against outer wheel bearing using wrench socket CPR102292-2. Provide for sufficient clearance between brake shoe and drum so that drag will not interfere with bearing adjustment.

(3) Initially, tighten nut to 200 lb.-ft. torque while hub is being rotated in both directions. Then, back off nut and retighten adjusting nut to 50 lb.-ft. torque while rotating hub in both directions to correctly position bearings.

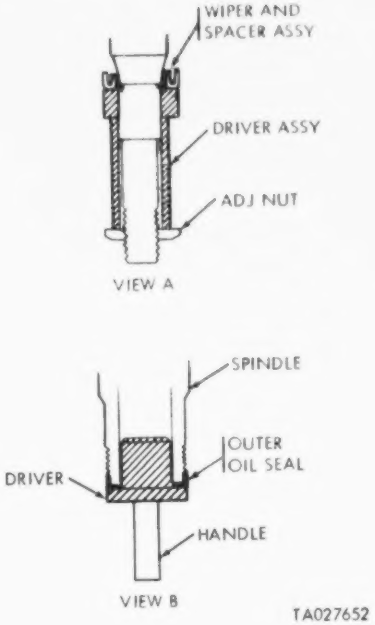


Figure 2-214. Using drivers CPR102296 and CPR102297 to install wiper and spacer assembly and outer oil seal.

(4) Back off adjusting nut ¼ to ⅓ turn.

(5) Assemble pierced washer and jamnut. Use wrench socket CPR102292-2 to tighten jamnut between 250 and 400 lb.-ft. torque.

(6) Install outer oil seal and gasket on hub studs. Install drive shaft and cap assembly. Shaft may have to be turned slightly to aline shaft in carrier gear.

(7) Install eight dowels, lockwashers, and nuts on hub studs. Tighten nuts to 160-205 lb.-ft. torque.

NOTE

Severely worn or deformed dowels should be replaced.

(8) Install feeler gage between drum and brake lining through slot in dust shield. If clearance is more than 0.060 inch, adjust brakes manually to achieve required 0.040 to 0.060 inch clearance (para 2-115).

Section XXIII. STEERING SYSTEM

2-132. Description and Data

a. General. The M746 tractor steering system has a mechanical linkage arrangement that must be assisted by hydraulic power. The mechanical components are steering wheel, steering column, steering gear, steering arm, drag link, a frame mounted idler-arm, reach rods, and tie rods (fig. 2-215). Due to the size and weight of the vehicle, manual steering alone is not possible. Hydraulic power must always be available to provide hydraulic steering power. For this reason, the tractor has both a main and an auxiliary power steering system. The main power steering system utilizes an engine driven hydraulic pump. The auxiliary system uses an axle driven hydraulic pump. So long as the vehicle is moving more than approximately four mph when the main pump (or engine) fails, the auxiliary system automatically applies. Both main and auxiliary pumps draw hydraulic fluid from the dual purpose reservoir.

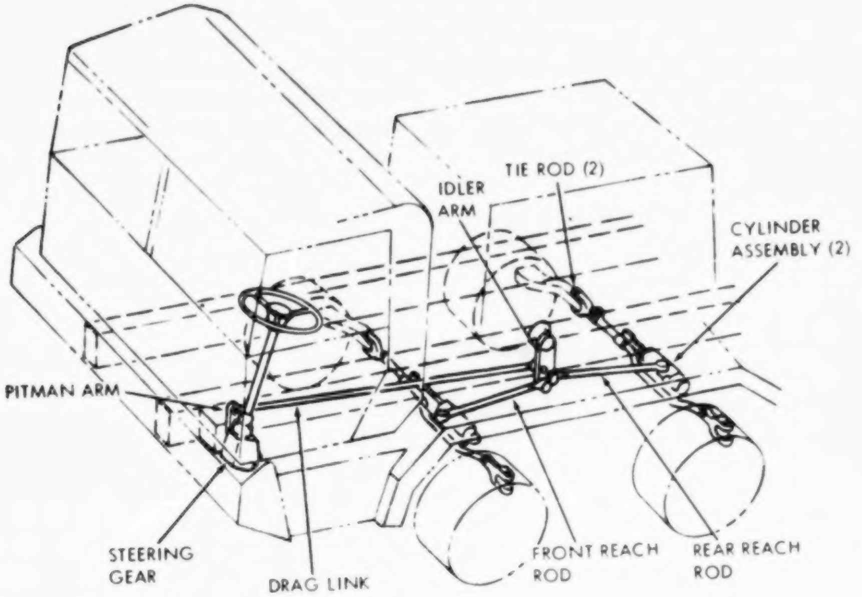


Figure 2-215. Mechanical steering linkage.

b. Main Power Steering System (Fig. 2-216).

(1) The main power steering system consists of the engine belt driven hydraulic pump with an integral flow control valve and relief valve, the steering gear control valve assembly, the transfer valve, two hydraulic cylinders, and the interconnecting hoses and tubing. Pressurized oil from the pump is routed by the steering gear control valve either back to the reservoir or to the steering cylinders which then extend or contract to steer the wheels. The steering gear control valve assembly is mounted at the base of the steering column and is controlled by motion of the steering wheel. When the steering wheel is turned to the right, pressurized oil is routed through the upper cylinder port in the steering gear control valve and through the line to the rod side of the power steering cylinder pistons. The increase of oil pressure at the rod side of the cylinder pistons causes the rod to withdraw into the cylinder forcing the tie rod to the left which turns the wheels to the right. Conversely, when the steering wheel is turned to the left, pressurized oil is routed through the lower cylinder port in the control valve and through the line to the full side of the power steering cylinder pistons. The increase of oil pressure at the full side causes the rod to extend from the cylinders, forcing the tie rod to the right, which turns the wheels to the left. When the steering wheel is straight ahead, pressurized oil is merely routed by the steering gear control valve back to the reservoir.

(2) Main pump discharge of 10 gpm maximum at greater than 860 rpm, is proportional to engine speed below 860 rpm. Oil flow, however, is regulated by internal relief and flow control valves so that system pressure is limited between 900 and 1000 psig. Surplus oil is trimmed by the relief valve and diverted to the reservoir.

(3) Regulated pressurized oil from the pump and the integral flow control valve passes through the transfer valve to the steering gear control valve. The transfer valve is provided to automatically utilize auxiliary system pressure when the main system fails. However, when the main pump is operating, pressurized oil reaches the transfer valve through the input line and shifts the valve spool to route main system oil to the steering gear control valve.

(4) A check valve built into the transfer valve prevents back pressure at the valve pressure outlet from overcoming pilot line pressure and shifting the spool unnecessarily.

c. Auxiliary Power Steering System.

(1) The auxiliary power steering system consists of a front axle mounted, axle driven, auxiliary hydraulic pump; the transfer valve, a separate flow control valve, a pressure switch and a check valve. The auxiliary system pump operates whenever the vehicle is in motion and the front axle carrier thru-shaft is turning. The pump draws oil from the dual purpose reservoir. When the main power steering pump is operating, discharge oil from the auxiliary pump passes through the return port of the transfer valve and back to the reservoir. This neutral circulation of auxiliary system oil occurs during normal vehicle operation. However, when the main power steering pump fails or when the engine is shut down and the tractor must be steered while coasting or when towed, the auxiliary power steering system is automatically

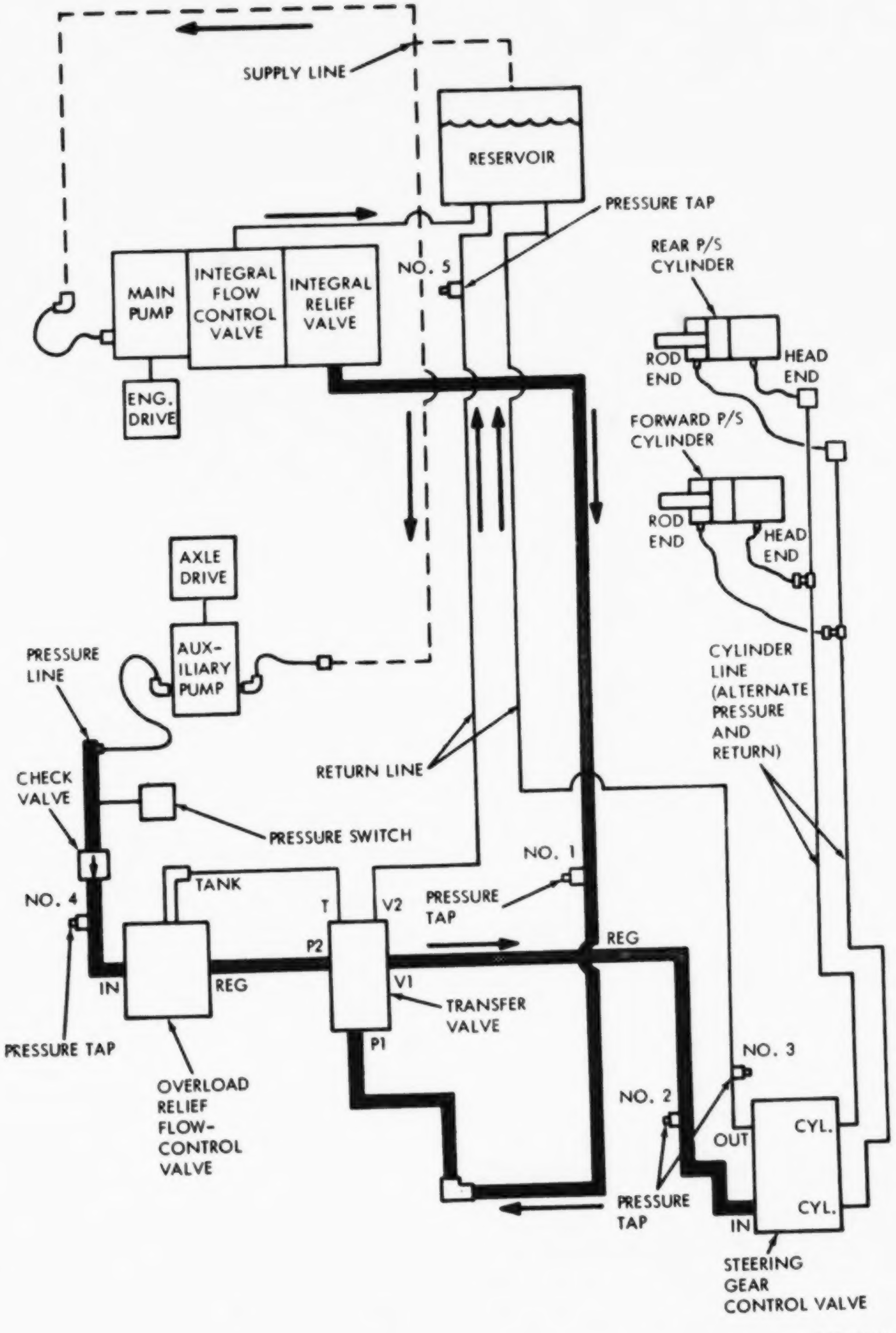

SUPPLY LINE
RESERVOIR
PRESSURE TAP
MAIN PUMP
INTEGRAL FLOW CONTROL VALVE
INTEGRAL RELIEF VALVE
NO. 5
ENG. DRIVE
REAR P/S CYLINDER
ROD END
HEAD END
FORWARD P/S CYLINDER
ROD END
HEAD END
AXLE DRIVE
AUX-ILIARY PUMP
PRESSURE LINE
CYLINDER LINE (ALTERNATE PRESSURE AND RETURN)
RETURN LINE
CHECK VALVE
PRESSURE SWITCH
NO. 1
TANK
T
V2
NO. 4
PRESSURE TAP
P2
REG
IN
REG
V1
TRANSFER VALVE
P1
PRESSURE TAP
NO. 3
NO. 2
OVERLOAD RELIEF FLOW-CONTROL VALVE
OUT
CYL.
CYL.
IN
PRESSURE TAP
STEERING GEAR CONTROL VALVE
TA027654

Figure 2-216. Hydraulic power steering schematic.

applied to provide power assist. When the main pressure line from the main pump suffers a pressure loss, a pressure drop is caused in the input (PI) line to the transfer valve. A spring loaded spool in the transfer valve, normally held off by high input pressure, closes the return port to auxiliary pressurized oil and allows auxiliary flow to pass to the steering gear control valve. The auxiliary pump thus replaces the main pump as the source of pressurized oil to the power steering cylinders. The tractor must be moving approximately 4 mph minimum before the auxiliary power steering system operates effectively.

(2) The flow control valve regulates the system pressure between 1000 and 1050 psi. It also diverts surplus oil to the reservoir.

(3) The pressure switch controls the auxiliary power steering warning light in the cab. The switch opens to shut the warning light off when system pressure increases above 150 plus or minus 10 psi. The light remains off as the auxiliary system pressure reaches operating range. The pressure switch closes, turning the warning light on, if system pressure decreases below 125 psi, indicating a failure in the auxiliary power steering system. The check valve assures positive pressure at the pressure switch to prevent it from operating the warning light needlessly.

d. Steering Gear and Control Valve Assembly (figs. 2-217 and 2-218).

(1) The steering gear transfers the torque to the steering linkage that the operator applies to the steering wheel. The steering gear also directs hydraulic power from the pump pressure lines to the power steering cylinders. Integral with the mechanical gears is a four-way directional control valve that routes hydraulic flow to either end of the power steering cylinders to assist turning. When the steering wheel is turned by the operator, the stud of the inner lever is moved through the worm gear of the cam and shaft assembly (fig. 2-217). This rotates the lever shaft, providing angular movement of the steering arm and axial movement of the cam and shaft assembly due to a telescopic coupling arrangement in the steering column. The movement of the steering arm draws or pushes the linkage that turns the wheels. Because of the size and weight of the vehicle, the steering cannot be moved by turning the steering wheel, without hydraulic assist. Axial movement of the cam and shaft assembly causes the spool to move in the hydraulic control valve. The control valve spool actuator, fixed on the cam and shaft assembly, moves with the cam and shaft after a certain small travel has been reached. This opens hydraulic ports to supply the assist cylinders on the axles.

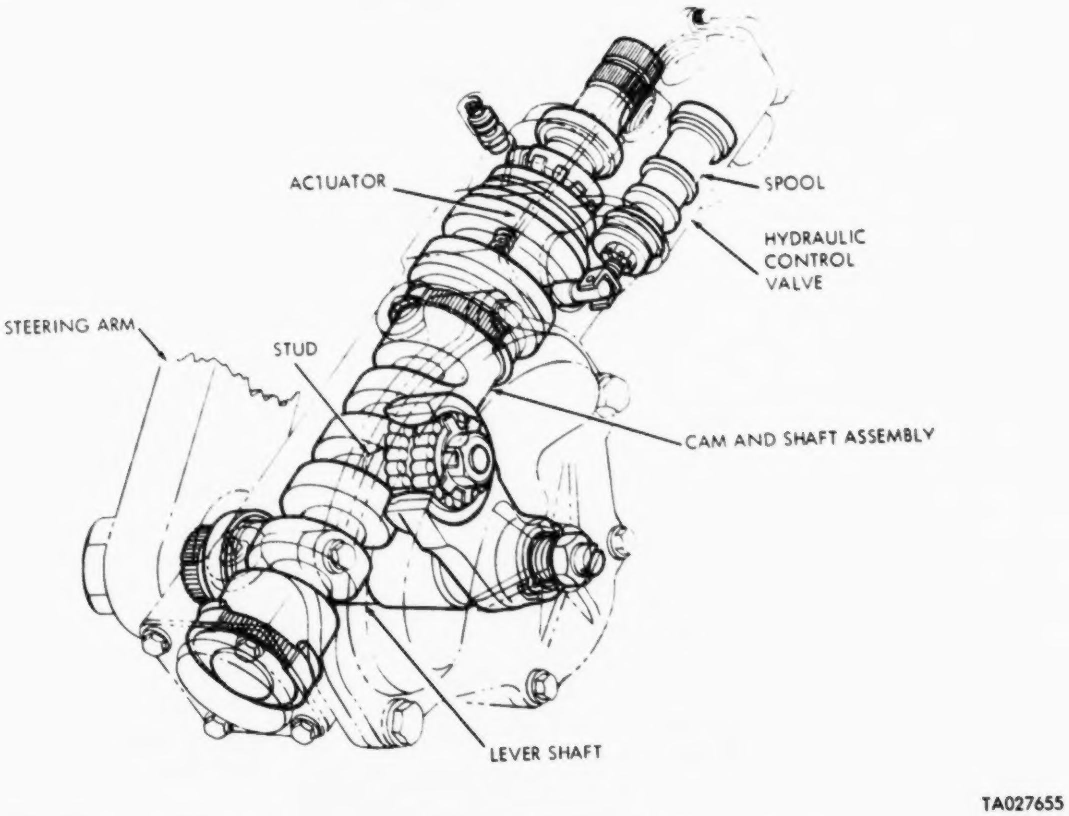


Figure 2-217. Steering gear assembly.

(2) When the actuator is moved, the actuator lever moves the control valve spool either forward or rearward from its center or neutral position. Hydraulic flow from the pressure inlet to the return port ceases and one of two cylinder ports opens to the pressurized oil. At the same time, the other of the two cylinder ports opens to the valve outlet port allowing oil to retreat from the low pressure end of the cylinders. The slightest movement of the spool will cause a pressure response in the cylinders, and a spool travel of only .064 inch will cause full hydraulic power to be applied. When steered wheels are subjected to road shocks, movement of the cylinders and kickbacks at the steering wheel are prevented. At such times, the force of the shock load is transferred through the steering linkage to the steering gear; as the steering gear cam and shaft assembly moves, it moves the hydraulic control valve spool axially in the appropriate direction thsu directing fluid to the proper end of the cylinder to resist the shock forces. The control valve uses hydraulic pressure to urge the valve spool to its neutral or center position. As the pressure in the cylinders builds up, the hydraulic centering force increases. Thus, the effort to steer is greater while turning the tractor than in a straight ahead road correction condition.

(3) "Road feel" while driving straight ahead is achieved through several factors. The worm groove of the cam and shaft assembly is a cam tapering outward from the center of the gear. The stud of the lever shaft, riding in the worm groove, thus fits very close when the cam and shaft assembly is centered and the wheels are straight. This arrangement results in minimal free play in the steering gear and gives the operator a close feel of road conditions. Centering springs with a fixed preload provide the force to produce desired steering effort at the steering wheel. The cam and shaft assembly must work against these springs in order to travel slightly from its center position before it moves the control valve actuator (fig. 2-218). Otherwise, "road feel" would be obliterated by the presence of hydraulic forces.

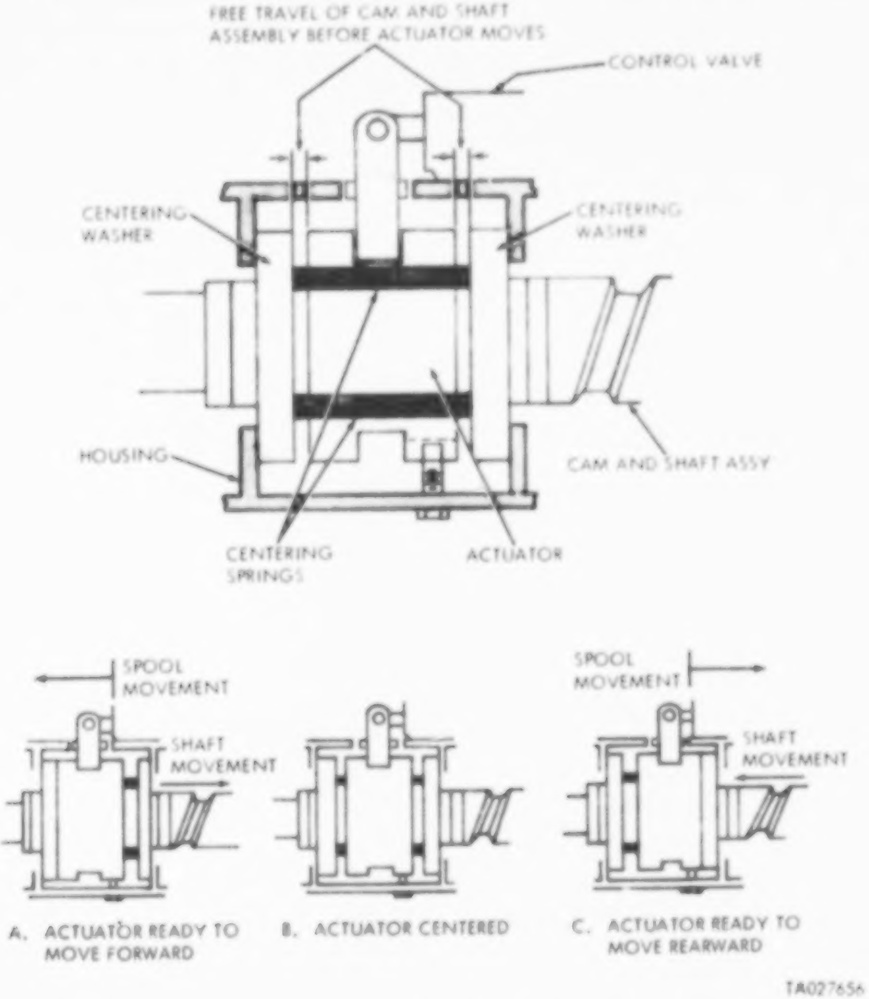

FREE TRAVEL OF CAM AND SHAFT ASSEMBLY BEFORE ACTUATOR MOVES
CONTROL VALVE
CENTERING WASHER
CENTERING WASHER
HOUSING
CAM AND SHAFT ASSY
CENTERING SPRINGS
ACTUATOR
SPOOL MOVEMENT
SHAFT MOVEMENT
SPOOL MOVEMENT
SHAFT MOVEMENT
A. ACTUATOR READY TO MOVE FORWARD
B. ACTUATOR CENTERED
C. ACTUATOR READY TO MOVE REARWARD
TA027656

Figure 2-218. Semi-integration of hydraulic and mechanical operation in steering gear.

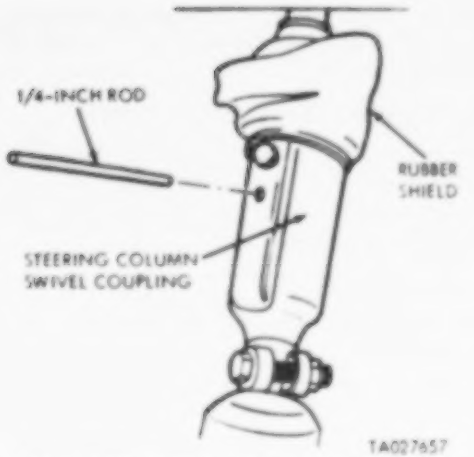

1/4-INCH ROD
RUBBER SHIELD
STEERING COLUMN SWIVEL COUPLING
TA027657

Figure 2-219. Using ¼-inch rod in adjustment of steering column height

e. Tabulated Data. Refer to paragraph 1-7.

2-133. Filling and Bleeding Procedure.

See paragraph 2-169 for filling the hydraulic system and bleeding the system by use of steering wheel only.

2-134. Adjust Steering Column Height

Fig. 2-219

a. Open cab front access door to expose steering column swivel coupling.

b. Push back rubber boot that covers swivel coupling. Turn steering wheel as required to bring hole in swivel coupling to accessible position.

c. Loosen clamp that secures steering column to cab panel and lower column by pushing down on steering wheel.

d. Insert ¼ inch diameter rod in hole.

e. Raise steering column by pulling up on steering wheel until motion is stopped by rod in hole.

f. Carefully lower column ⅛-inch below stopping point and clamp column securely to cab panel. Tighten clamp screws to 25-30 lb.-ft. torque.

CAUTION

Be sure to adjust column correctly. An improperly adjusted column can cause the steering gear to malfunction and result in erratic steering.

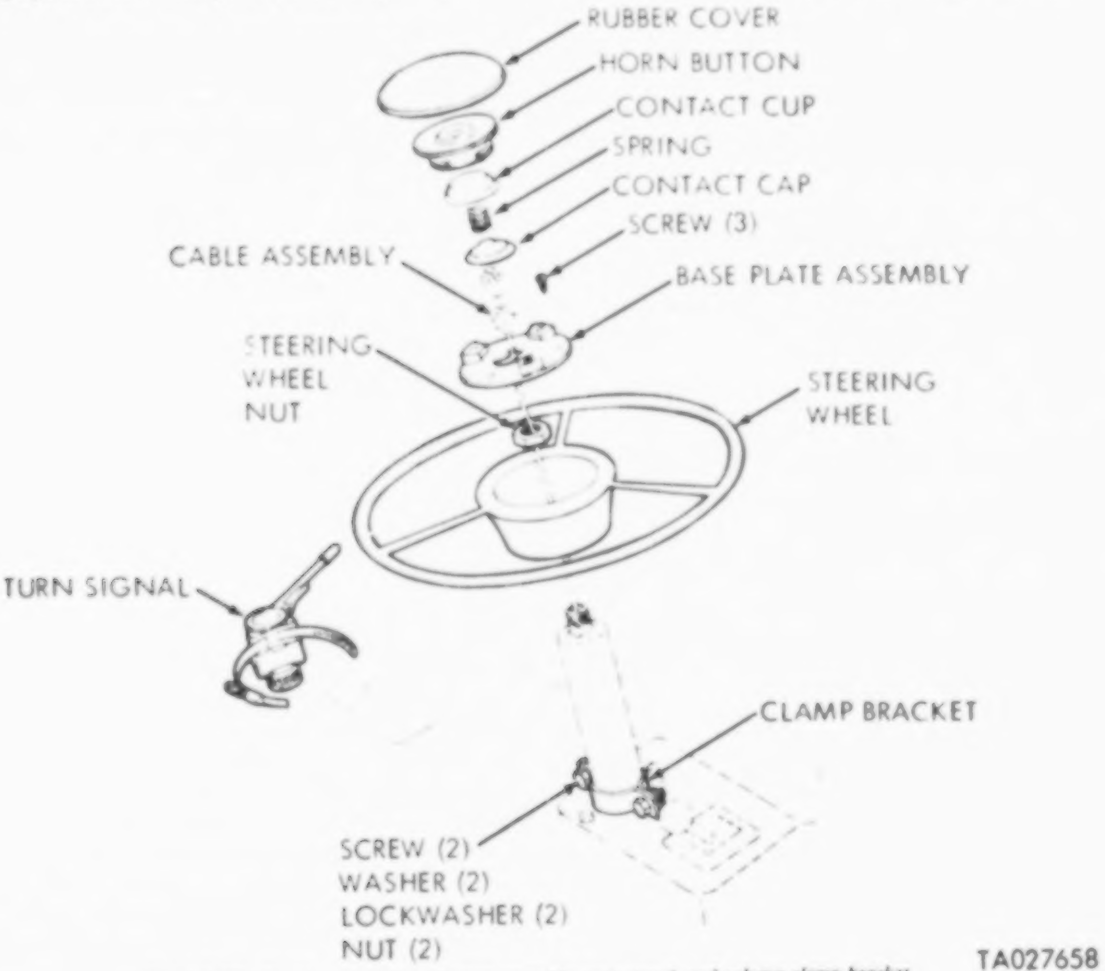

RUBBER COVER
HORN BUTTON
CONTACT CUP
SPRING
CONTACT CAP
SCREW (3)
CABLE ASSEMBLY
BASE PLATE ASSEMBLY
STEERING WHEEL NUT
STEERING WHEEL
TURN SIGNAL
CLAMP BRACKET
SCREW (2)
WASHER (2)
LOCKWASHER (2)
NUT (2)
TA027658

Figure 2-220. Steering wheel, horn button assembly, turn signal, and column clamp bracket.

2-135. Steering Wheel

a. Removal (figs. 2-220 and 2-221).

(1) Remove horn button cover by prying and pulling upwards.

(2) Remove horn button by pressing down and turning to the right or left with palm of hand, holding steering wheel firm.

(3) Remove contact cup, spring, and contact cap.

(4) Remove three screws holding base plate assembly in steering wheel pocket.

(5) Slide cable assembly from center hole in base plate assembly to larger hole at side and remove base plate assembly.

(6) Remove steering wheel nut.

(7) Use suitable puller and remove steering wheel (fig. 2-221).

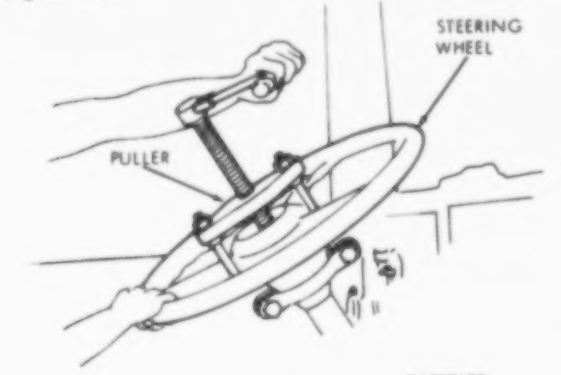

STEERING WHEEL
PULLER
TA027659

Figure 2-221. Removal and installation of steering wheel.

b. Installation.

(1) Position steering wheel on jacket tube of steering column. Wheel should be installed so spokes are in shape of a "Y" when viewed from driver's seat with front wheels straight ahead.

2-136. Steering Gear Adjustment

a. General. The steering gear assembly may require adjustment of stud in cam groove from time to time. The troubleshooting table 2-8 lists the malfunctions for which an adjustment is required.

NOTE

It is preferable to have the steering gear removed from the vehicle (para 2-137) for making adjustment. If adjustment is attempted while the steering gear is on the vehicle, it is necessary that the gear be free of all load; disconnect the drag link from the steering gear arm, loosen the steering column clamp in the cab, and disconnect steering column from gear.

b. Adjustment of Stud in Cam Groove.

(1) Loosen locknut (fig. 2-222) while holding adjusting screw with screw driver.

(2) Turn adjusting screw clockwise in side cover until a very slight drag (high spot) is felt when turning the gear input shaft through mid-position. It is recommended that this adjustment be done by rotating the input shaft with the fingers only as this will result in the desired minimal drag.

(3) Tighten lock nut while holding adjusting screw in position with screw driver.

(4) Turn gear through full travel (extreme left turn to extreme right turn) to check adjustment. Repeat procedure (2) and (3) above if light drag is not felt when turning gear through mid-position. If light drag is not felt this time, notify support personnel for adjustment

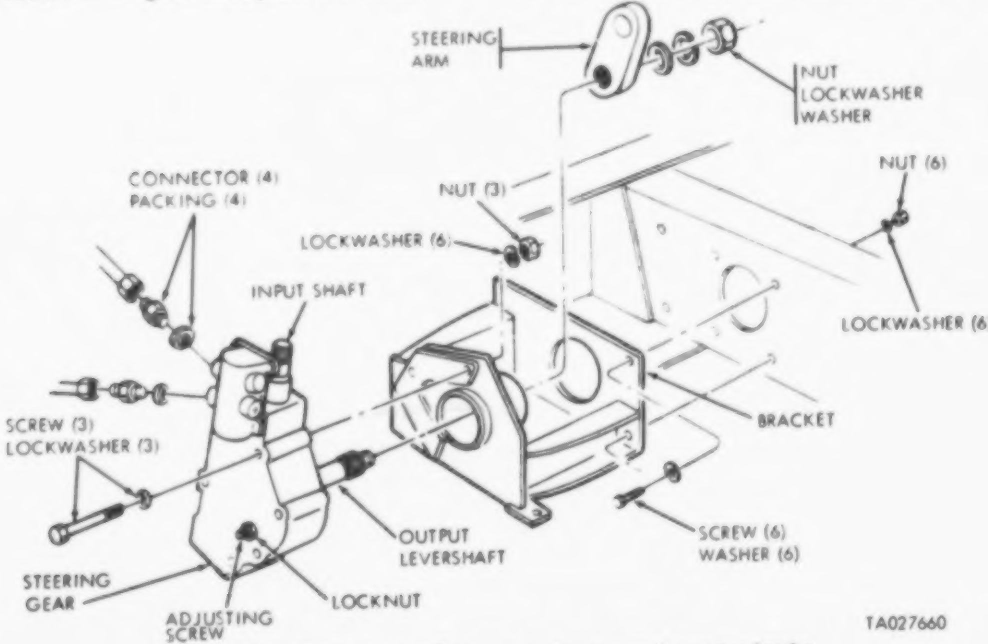

STEERING ARM
NUT
LOCKWASHER
WASHER
CONNECTOR (4)
PACKING (4)
NUT (3)
LOCKWASHER (6)
NUT (6)
INPUT SHAFT
LOCKWASHER (6)
BRACKET
SCREW (3)
LOCKWASHER (3)
OUTPUT LEVERSHAFT
SCREW (6)
WASHER (6)
STEERING GEAR
LOCKNUT
ADJUSTING SCREW
TA027660

Figure 2-222. Removal or installation of steering gear and mounting bracket.

of stud roller bearing.

2-137. Steering Gear

Fig. 2-222

a. Removal of Steering Gear.

(1) Disconnect and plug hydraulic lines to steering gear control valve.

(2) Disconnect socket assembly from steering arm.

(3) Remove nut, lockwasher, and washer from gear levershaft and remove steering arm. If tight fit of steering arm is encountered, use puller CPR104422 through hole in frame rail to remove steering arm.

(4) Loosen clamp securing steering column coupling shell to gear shaft and separate coupling shell from gear.

(5) Remove three screws securing steering gear to mounting bracket. Remove steering gear, and, if required, remove hydraulic fittings and preformed packing from control valve ports.

b. Installation of Steering Gear.

(1) Position steering gear at mounting bracket and secure using three screws, lockwashers, and nuts. Tighten nuts to 90 to 100 lb.-ft. torque.

(2) Adjust gear input/output shafts to centered position. This is accomplished by alining the index mark on the gear levershaft (output) perpendicular to the axis of the gear input shaft (fig. 2-223).

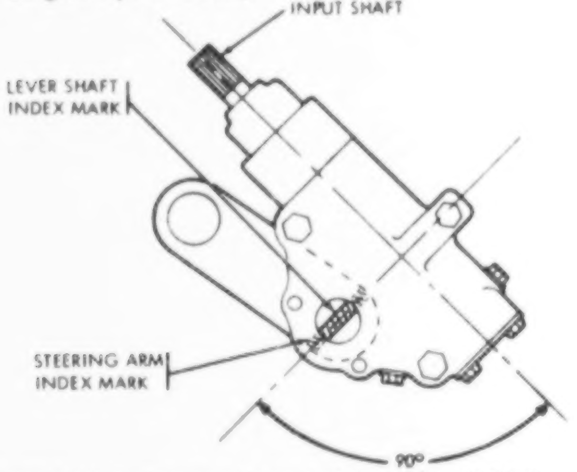


Figure 2-223. Centering steering gear by index marks. TA027661

(3) Position steering column coupling shell on gear shaft. Be sure coupling shell is alined axially with gear shaft. Secure coupling by tightening nut, lockwasher, and screw on coupling clamp to 25-30 lb.-ft. torque.

(4) Aline index mark on steering arm with index mark on end of gear levershaft, and install steering arm. Secure using washer, lockwasher, and nut. Tighten nut to 250 to 275 lb.-ft. torque.

(5) Turn steering wheel until steering arm is alined with drag link socket assembly stud. Secure socket assembly stud to steering arm using lockwasher and nut. Tighten nut to 250-275 lb.-ft. torque and install cotter pin.

(6) Install new packing in hydraulic ports of control valve and install four connectors. Connect hydraulic lines to connectors.

c. Removal of Steering Gear Mounting Bracket. With steering gear removed from vehicle (*a* above), remove six nuts, lockwashers, and screws securing mounting bracket to vehicle frame rail. Remove mounting bracket.

d. Installation of Steering Gear Mounting Bracket. Secure mounting bracket to vehicle frame rail by attaching six screws, lockwashers, and nuts. Tighten nuts securing bracket to frame to 90-100 lb.-ft. torque.

2-138. Steering Ball and Socket

Fig. 2-224

a. General. The steering ball and socket is mounted on the front tandem axle bracket. The ball and socket will require replacement from time to time due to wear. Perform wear inspection and removal as follows:

b. Removal and Inspection of Ball Stud and Socket.

(1) Raise and support front tandem wheels off ground.

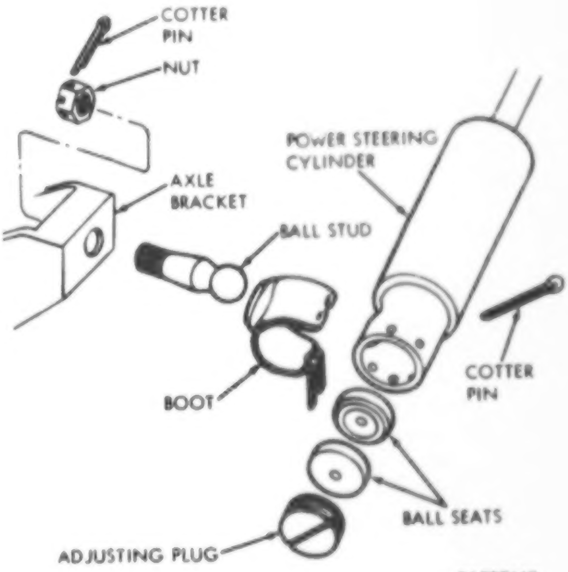
(2) Remove cotter pin and remove adjusting plug from cylinder end using two screwdrivers as shown in figure 2-224.

(3) Support cylinder with block, jack, or stand and move cylinder carefully off ball portion of ball stud. Inspect ball visually and with hand for flat spots. Replace ball stud if flat spot(s) is found. Replace ball seats if heavily worn.

c. Installation of Ball Stud and Socket.

(1) Lubricate ball before installing.

(2) Attach adjusting plug to cylinder and adjust plug torque to 50 lbs-ft. Then back off 1/16 to 3/16 turn to aline cotter pin hole. Install cotter pin.



TA027662

Figure 2-224. Cylinder ball and socket — exploded view.

2-139. Main Power Steering Pump

Fig. 2-225

a. *Removal.*

NOTE

Provide a suitable container and splash plate to drain residue fluid during parts removal (less than one gallon). Position beneath work area.

(1) Disconnect three tubes in secondary and primary ports.

(2) Remove adapters and packing from each port.

(3) Plug each open port and each open tube to prevent contamination.

(4) Remove two screws, washers, lockwashers, and nuts securing pump to plate.

(5) Lift pump and remove belts from pump pulley.

(6) Remove pump from engine area being careful to avoid damage to adjacent tubing.

(7) Remove tubes, hoses, brackets, and fittings as required for replacement purposes.

(8) Remove nut and machine key from pump drive shaft and use puller to remove pulley from pump.

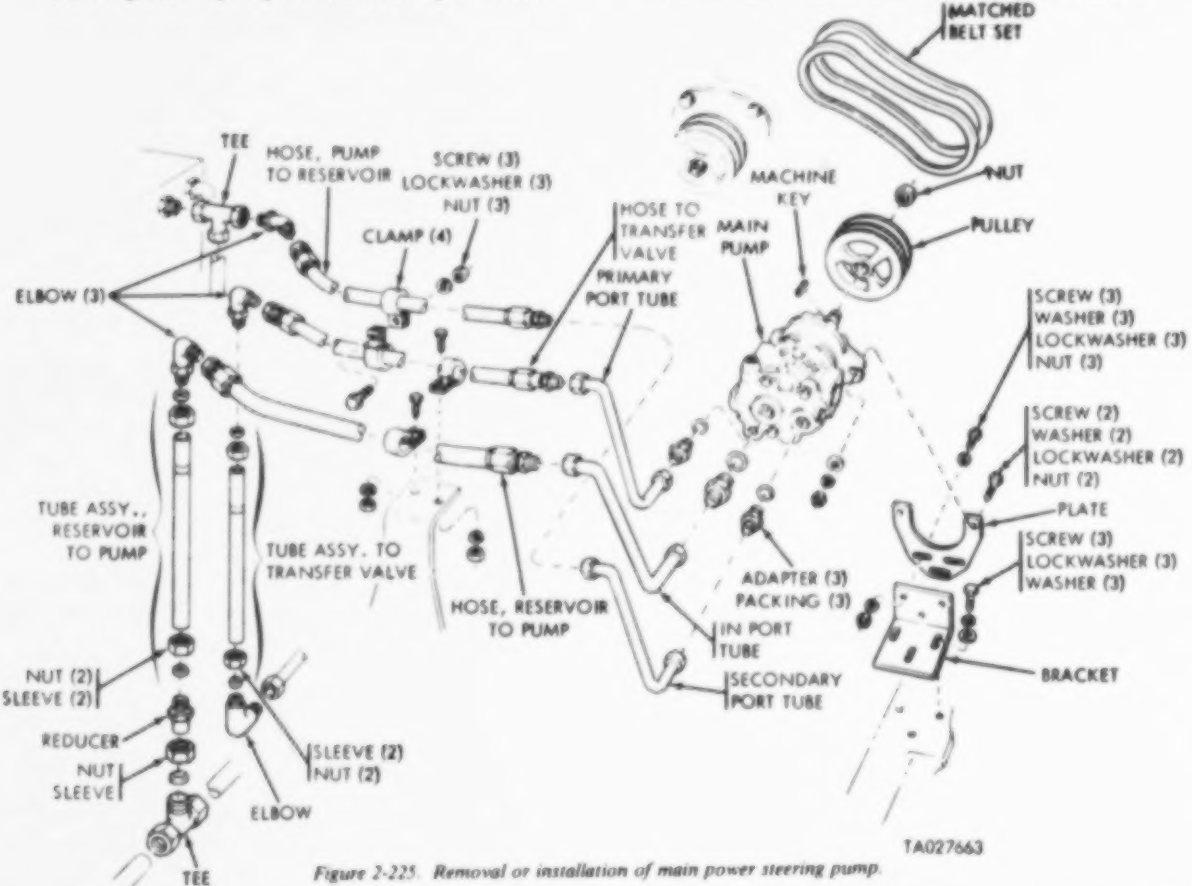

MATCHED BELT SET
TEE
HOSE, PUMP TO RESERVOIR
SCREW (3)
LOCKWASHER (3)
NUT (3)
CLAMP (4)
MACHINE KEY
NUT
HOSE TO TRANSFER VALVE
MAIN PUMP
PULLEY
PRIMARY PORT TUBE
ELBOW (3)
SCREW (3)
WASHER (3)
LOCKWASHER (3)
NUT (3)
SCREW (2)
WASHER (2)
LOCKWASHER (2)
NUT (2)
PLATE
TUBE ASSY., RESERVOIR TO PUMP
TUBE ASSY. TO TRANSFER VALVE
SCREW (3)
LOCKWASHER (3)
WASHER (3)
ADAPTER (3)
PACKING (3)
HOSE, RESERVOIR TO PUMP
IN PORT TUBE
BRACKET
NUT (2)
SLEEVE (2)
SECONDARY PORT TUBE
REDUCER
NUT
SLEEVE
SLEEVE (2)
NUT (2)
ELBOW
TEE
TA027663

Figure 2-225. Removal or installation of main power steering pump.

b. *Installation.*

(1) Install pulley on pump drive shaft and secure with machine key and nut.

(2) Position pump on mounting plate and install two screws, lockwashers, and nuts.

(3) Loosen nuts securing mounting plate to pump bracket and move plate until drive belts can be placed over pump pulley. Align pump pulley with drive pulley on engine. Tighten the power steering pump mounting brackets. Adjust tension on drive belts according to *c* below.

(4) Install adapters and preformed packing in each of the three pump ports.

(5) Install each of the three tubes to the appropriate pump adapter.

(6) Perform checkout of power steering hydraulic system (para 2-141*b*) after installation is complete and belt tension is within tolerance.

c. *Checking and Adjustment of Belt Tension.*

(1) Apply a 12 pound load to center of belt span on each belt and measure belt deflection. Deflection shall be less than 5/8 inch.

(2) To adjust, loosen nuts securing pump mounting plate to bracket. Place pry bar between pump and engine and pry downward to tighten belts.

(3) Tighten nuts securing pump mounting plate to bracket when belt tension is within tolerance.

2-140. Auxiliary Power Steering Pump

Fig. 2-226

a. Remove.

(1) Disconnect supply and discharge hoses at pump.

(2) Remove reducer and packing from both ports.

(3) Remove two screws and four washers securing pump to axle carrier assembly. Remove pump, gaskets, keyway washer, adapter, and key. The connecting collar and driver may or may not come out when the pump is removed.

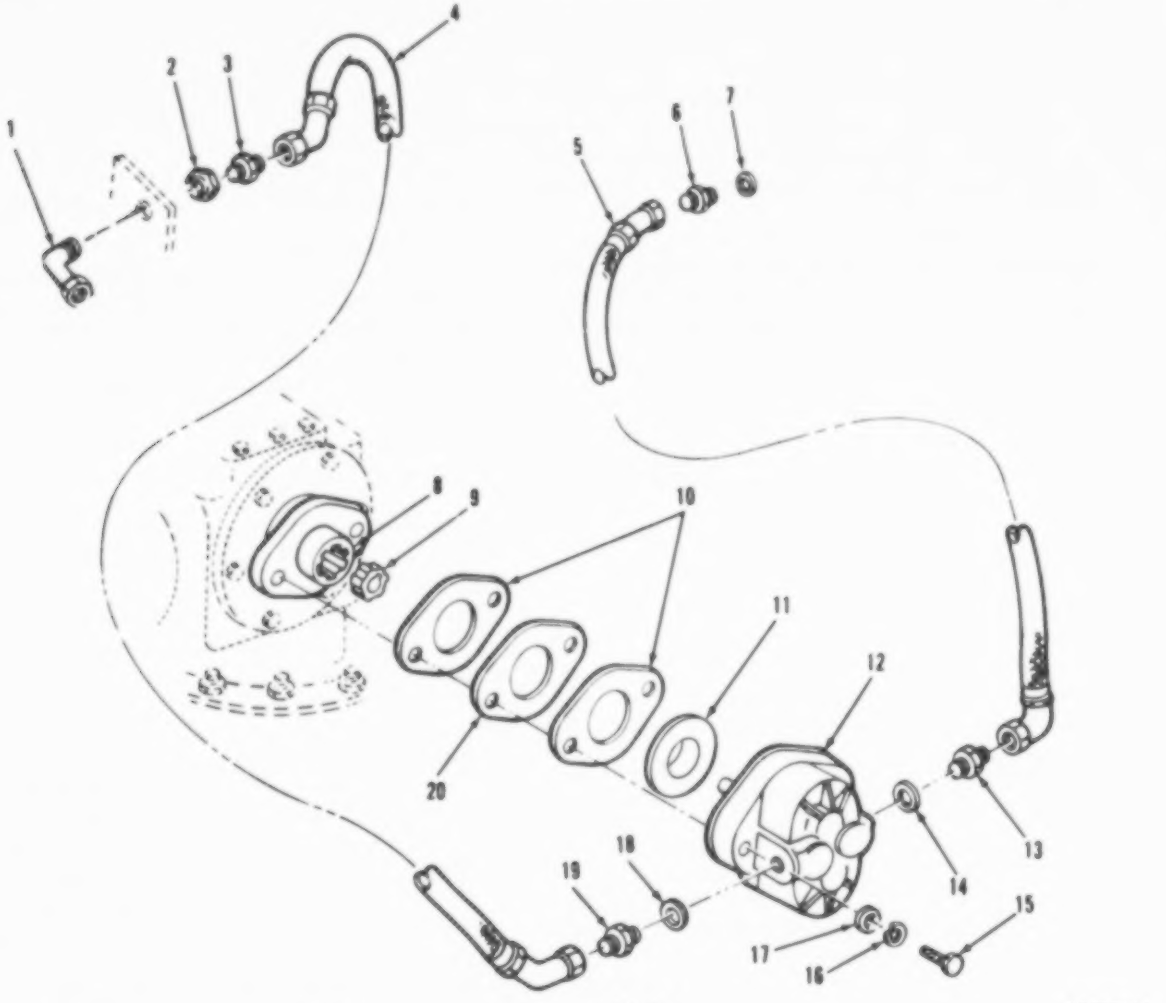
b. Install.

(1) Install new packing and reducer in pump inlet and outlet ports.

(2) Position key in pump shaft. Position gaskets, washer, and adapter on pump shaft and install pump using two screws and four washers. Be sure that collar and driver are installed and that no binding exists.

(3) Connect hydraulic hoses at pump.

(4) Perform power steering system check (para 2-141*b*) but put vehicle in motion at speeds greater than 5 mph. Bleed system of air, if necessary (para 2-169*b*).



1	Elbow	11	Washer
2	Nut	12	Pump, auxiliary
3	Union	13	Reducer
4	Hose assembly, discharge	14	Packing (2)
5	Hose assembly, supply	15	Screw (2)
6	Union	16	Lockwasher (2)
7	Packing	17	Washer, flat (2)
8	Collar	18	Packing
9	Driver	19	Reducer
10	Gasket (2)	20	Adapter

Figure 2-226. Removal or installation of auxiliary power steering pump.

2-141. Power Steering Hydraulic Lines and Fittings

Fig. 2-227

a. Replace Lines and Fittings.

(1) Drain about 20 gallons of oil from reservoir (to point below reservoir suction line outlet) into suitable *clean* container such as an empty oil drum.

(2) Provide suitable container and splash plate to drain residue fluid when opening line connections. Plug open ends of tubes or components to prevent contamination.

(3) Replace tubing that is dented, kinked, punctured or torn. Replace leaking fittings only if leak cannot be stopped by tightening.

CAUTION

Do not use pliers to tighten fittings. Use only suitable wrench.

(4) Refer to figures 2-227 and 2-228 for removal and installation of tubing. Clamp tubing in place where required.

(5) If oil drained from reservoir appears dirty or contaminated, refill with new engine oil OE-10, MIL-L-2104, in accordance with LO 9-2320-258-12. Check oil level after completion of work and bleed air from system according to paragraph 169*b*.

b. Power Steering System Checkout.

NOTE

If the steering wheel continues to turn in an erratic manner, it may be necessary to adjust the pressure relief setting in the integral flow control valve mounted on the main power steering pump. Refer to paragraph 2-142 for instructions on adjusting the relief setting.

(1) Start engine and idle for five minutes. Note reservoir fluid level.

(2) At engine idle speed, turn wheels left and right several times and note reservoir fluid level.

(3) Increase engine speed and turn wheels to left. Go back to idle and turn wheels right.

(4) Increase engine speed and turn wheels to right. Go back to idle and turn wheels left.

(5) Note reservoir fluid level and, if required, fill reservoir to top of sight gage.

(6) During check, observe all components, tubes, hoses and fittings for possible leakage. Check hose routing and placement for possible interference or rubbing.

c. Check Power Steering Hydraulic Pressure.

(1) *Pressure taps.* Check power steering hydraulic pressure (done in conjunction with troubleshooting table 2-8) is done at one or two of five pressure taps on the hydraulic lines. Refer to figure 2-216 for pressure tap locations.

(2) *Pressure check.* Install pressure gage with engine stopped and hydraulic pressure depleted (turn steering wheel to deplete pressure, if necessary). Remove plug from desired pressure tap(s) and install adapter(s). Install pressure gage(s) 10946819 in adapter(s). Start engine. Refer to table 2-8 for specific pressure checks.

2-142. Power Steering Hydraulic Valves

Fig. 2-228

a. Overload Relief - Flow Control Valve (38).

(1) *Removal.* Use suitable container below valve to catch residue fluid from lines. Disconnect three tube assemblies (29, 30, and 41) from fittings in valve (38). Remove two screws (39) and lockwashers (13) that secure valve at mounting point. Remove valve. Plug open tube ends to prevent contaminants from entering unless valve is replaced immediately. Remove three fittings (36) and packing (37) from valve.

(2) *Installation.* Use new packing and install three fittings (36) in valve. Unplug open tube ends placed to prevent contaminants from entering valve (38) unless valve is replaced immediately. Install valve and secure with two lockwashers (13) and screws (39). Connect three tube assemblies (29, 30, and 41) to fittings in valve.

b. Transfer Valve.

(1) *Removal.* Use suitable container below valve to catch residue fluid from lines. Disconnect tube assemblies at nipple (27), at adapters (19 and 20) and at elbow (22). Remove two lockwashers (24), screws (23), and washers (25). Remove transfer valve (26) from vehicle. Plug open tube ends to prevent contaminants from entering unless valve is replaced immediately. Remove fittings and packing from valve.

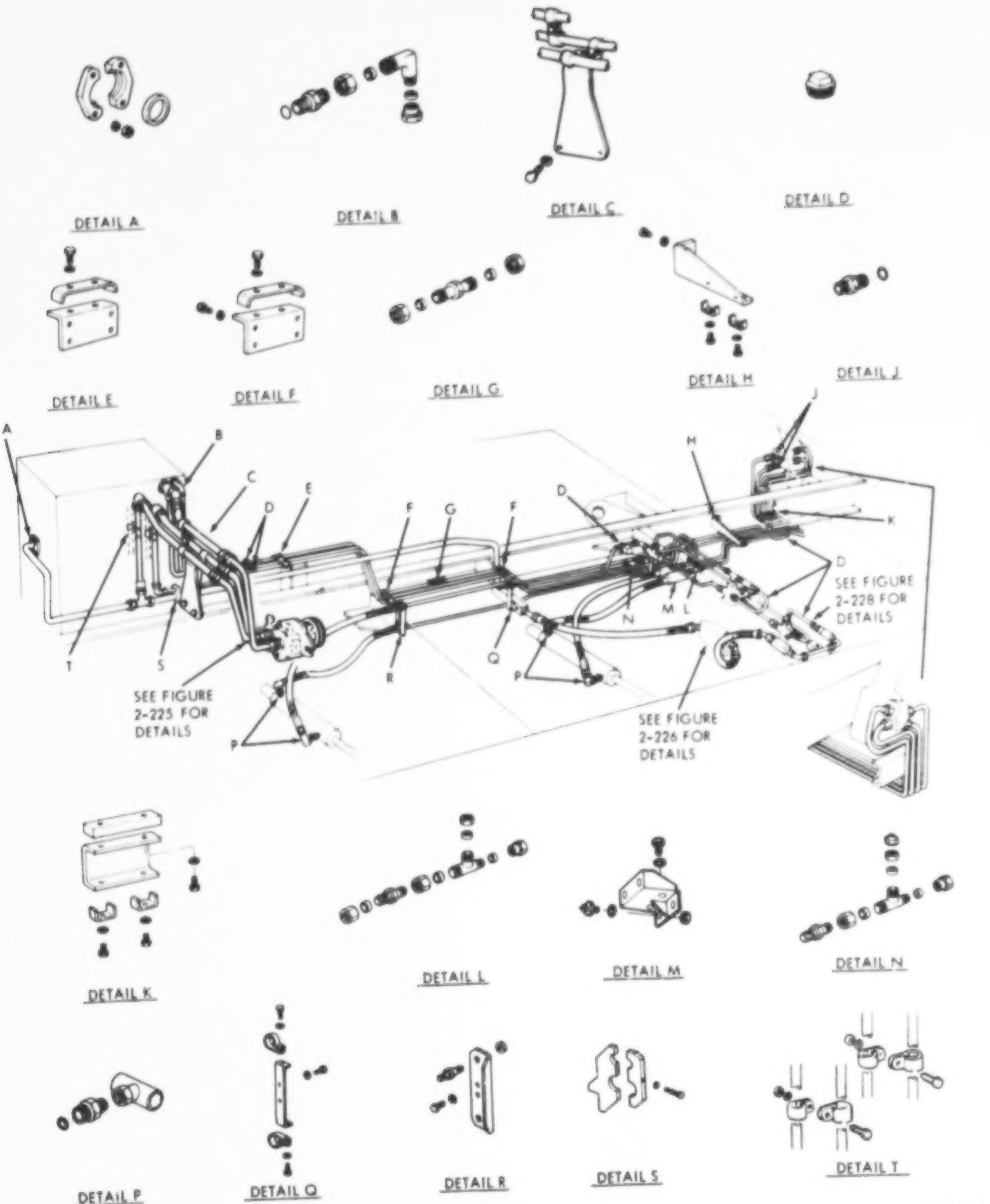
(2) *Installation.* Use new packing when installing valve and fittings. Unplug open tube ends as in (1) above. Attach transfer valve (20) to vehicle. Attach screws (23), lockwashers (24), and washers (25). Connect tube assemblies at nipple (27), at adapters (19 and 20) and at elbow (22). Remove container from below valve used to catch residue fluid from lines.

c. Pressure Switch.

(1) *Removal.* Remove two screws (48), lockwashers (47), and washers (46), securing switch (9) to mounting bracket (11). Remove two screws (6), washers (8), and lockwashers (7), securing mounting bracket (11) to bracket (45). Remove bracket (11) and pad (10). Unscrew pressure switch from fitting on tube.

(2) *Installation.* Screw pressure switch into fitting on tube and attach bracket (11) with pad (10). Secure mounting bracket (11) to bracket (45) and attach two screws (6), washers (8), and lockwashers (7). Secure switch (9) to mounting bracket (11) with two screws (48), lockwashers (47), and washers (46).

d. One-Way Check Valve. Remove one-way check valve (43) by disconecting tube assembly (2) from elbow (1) at check valve fitting and unscrewing check valve adapter (42) from other tube (41). To install, screw check valve adapter (42) to tube (41). Connect tube assembly (2) to elbow (1) at check valve fitting. Install one-way check valve (43).


DETAIL A
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SEE FIGURE 2-228 FOR DETAILS
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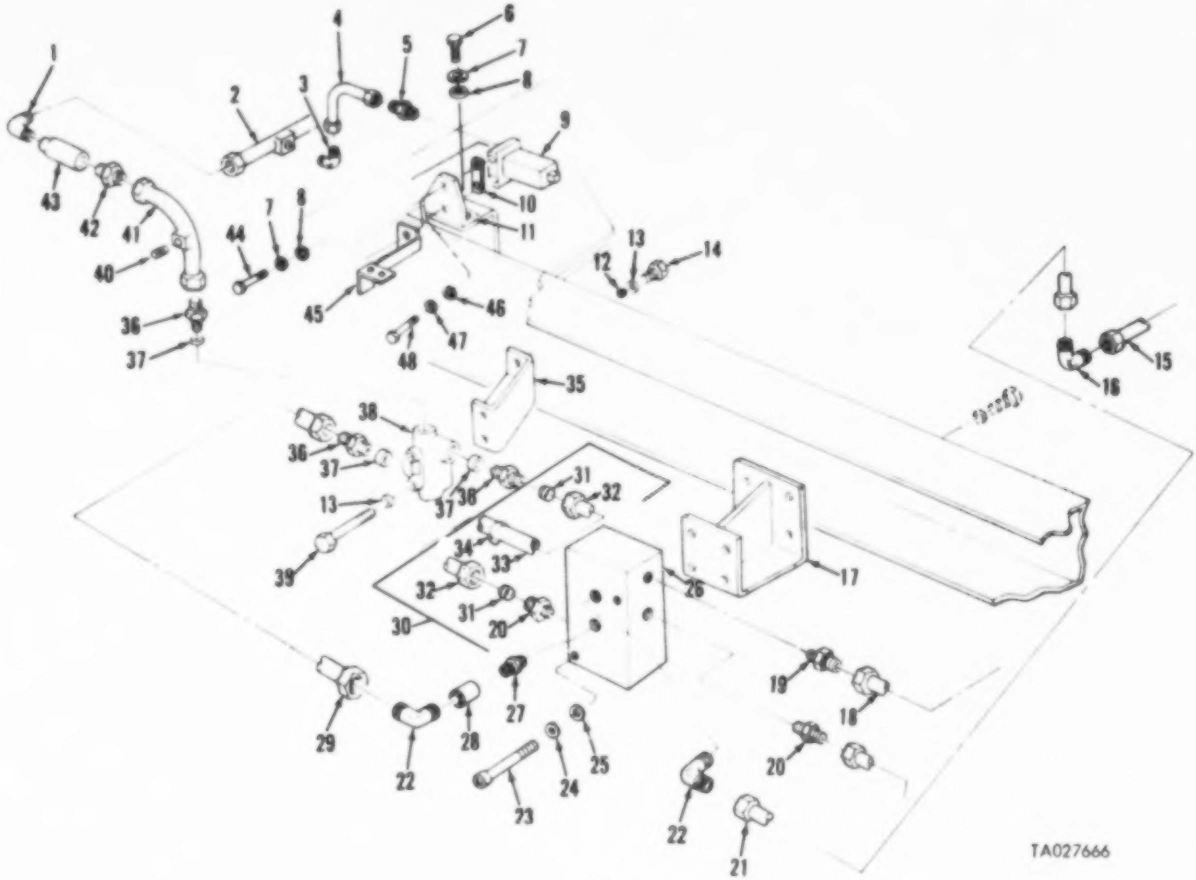
Figure 2-227. Power steering hydraulic lines and fittings, and clamp and bracket details.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TA027666

1 Elbow
2 Tube assembly
3 Elbow
4 Tube assembly
5 Adapter
6 Screw (2)
7 Lockwasher (4)
8 Flat washer (4)
9 Auxiliary pressure switch
10 Pad
11 Bracket
12 Flat washer (2)
13 Lockwasher (4)
14 Screw (2)
15 Tube assembly
16 Elbow
17 Bracket
18 Tube assembly
19 Adapter
20 Adapter (2)
21 Tube assembly
22 Elbow (2)
23 Screw (2)
24 Lockwasher (2)
25 Washer (2)
26 Transfer valve
27 Nipple
28 Coupling
29 Tube assembly
30 Tube assembly
31 Sleeve (2)
32 Nut (2)
33 Tube
34 Band
35 Bracket assembly
36 Reducer (3)
37 Preformed packing (3)
38 Flow control valve
39 Screw (2)
40 Pipe plug
41 Tube assembly
42 Adapter
43 Check valve
44 Screw (2)
45 Bracket
46 Washer (2)
47 Lockwasher (2)
48 Screw (2)

Figure 2-228. Power steering hydraulic valves—exploded view.

Section XXIV. FRAME AND RELATED PARTS

2-143. Description

a. General. The frame consists of two main reinforced beam assemblies (side rails) to which crossmembers, gussets, brackets, and diagonal reinforcements are secured. The winch fifth wheel support plate is an integral part of the frame. The winch mounting brackets are welded to this support plate. Power plant mounts, front bumper, shrouds and forward decking, towing pintle, lifting eyes, tie-down shackles, fifth wheel and ramps, trailer air coupling trestle, fuel tank support, hydraulic reservoir supports, axle tandem mounting brackets, idler arm mounting bracket, and rear fenders are all secured to the frame. Various air and hydraulic valve and fitting brackets are also secured to the frame.

b. Shrouds and Forward Decking. The power plant shroud and forward decking are bolted to the frame on either side of the power plant compartment. The stowage compartment is integral with the right shroud assembly. Access panels to the power plant are located in both shroud assemblies. The engine compartment cover and support frame are attached to the shroud. The outer shroud walls are used to mount the air cleaners and flood light supports. The left deck is used to mount the davit and winch assembly support bracket.

c. Front Bumper. The front bumper serves as a frame crossmember and provides a mounting surface for the following: headlights, headlight guards and wiring, tow eyes, front cab mounts, and front diagonal reinforcements.

d. Rear Fenders. The rear fenders are of framework and sheet metal construction. A mud flap, and a support pocket for the rear composite light, are integral with each rear fender.

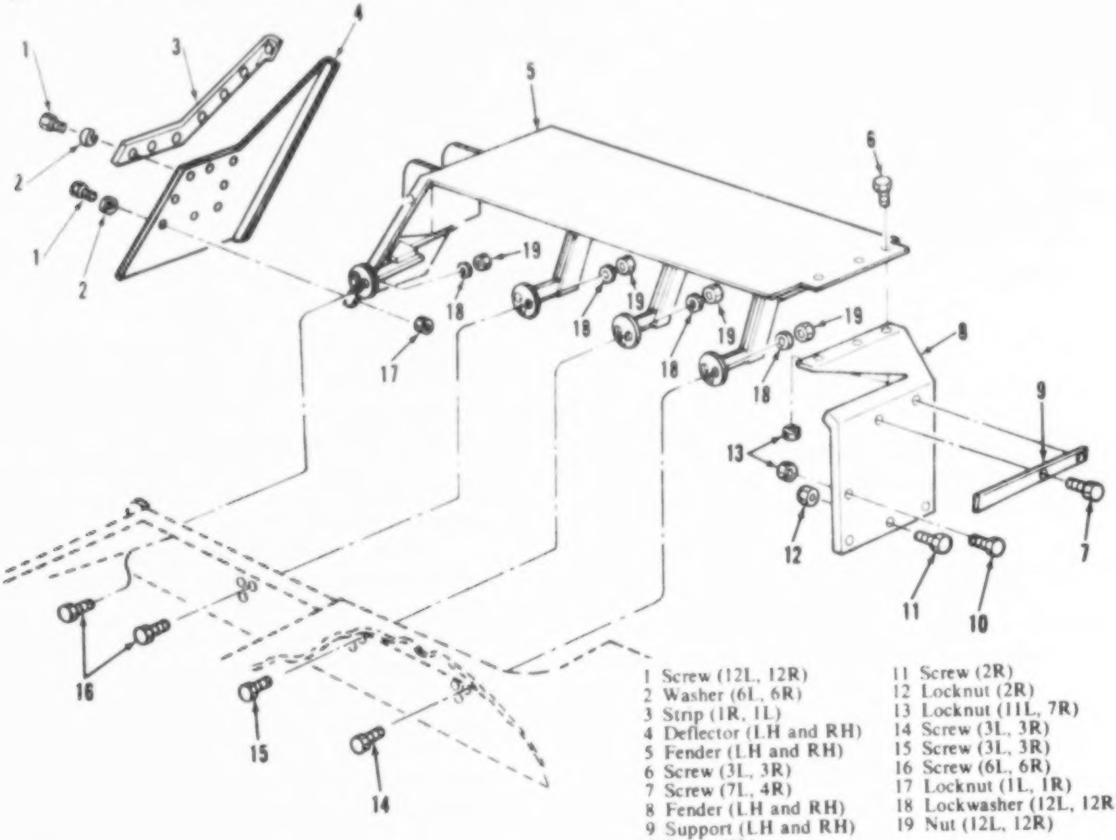
e. Fifth Wheel and Ramp. The fifth wheel is a 36-inch universal type (fig. 2-230). The fifth wheel mounting position is for the M747 semitrailer. The kingpin guide ramp is bolted to the rear crossmember at one end and to the winch fifth wheel support plate at the other end.

f. Towing Pintle. The towing pintle is mounted on the rear crossmember. The towing pintle is a heavy duty non-quick release type.

2-144. Rear Fender Assembly

Fig. 2-229

Refer to figure 2-229 and remove and replace fenders or deflectors as required.



1 Screw (12L, 12R)
2 Washer (6L, 6R)
3 Strip (1R, 1L)
4 Deflector (LH and RH)
5 Fender (LH and RH)
6 Screw (3L, 3R)
7 Screw (7L, 4R)
8 Fender (LH and RH)
9 Support (LH and RH)
10 Screw (1L)
11 Screw (2R)
12 Locknut (2R)
13 Locknut (11L, 7R)
14 Screw (3L, 3R)
15 Screw (3L, 3R)
16 Screw (6L, 6R)
17 Locknut (1L, 1R)
18 Lockwasher (12L, 12R)
19 Nut (12L, 12R)

TA027667

Figure 2-229. Rear fender assembly—exploded view.

2-145. Fifth Wheel and Ramps

Fig. 2-230

a. Removal. Remove 24 nuts, lockwashers, and bolts securing fifth wheel to frame. Lift fifth wheel from vehicle using suitable lifting device and sling. Remove 10 nuts, lockwashers, and bolts securing ramp to frame. Remove ramp from vehicle.

b. Installation. Position ramp to vehicle, install 10 bolts, lockwashers, and nuts securing ramp to frame. Lift fifth wheel to vehicle using suitable lifting device and sling. Tighten 24 nuts securing fith wheel to minimum of 125 lb.-ft. torque. Tighten six forward nuts on ramp to minimum of 125 lb.-ft. torque. Tighten four rear nuts on ramp to a minimum of 64 lb.-ft. torque. Lubricate fifth wheel following LO 9-2320-258-12.

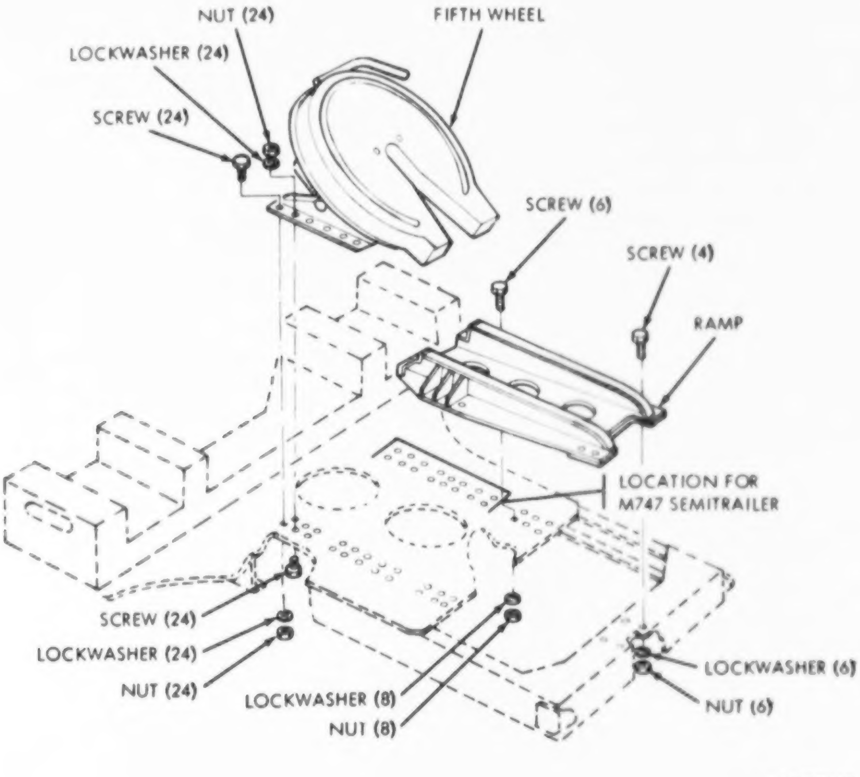


Figure 2-230. Fifth Wheel and ramp.

2-146. Pintle Hook Assembly

Fig. 2-231

a. Removal.

(1) Remove cotter pin (17) securing nut (16) on pintle hook shaft, and remove nut and washer (18).

(2) Remove for nuts (22), lockwashers (21), and screws (2) securing sleeve to frame.

(3) Remove pintle hook and sleeve from vehicle.

NOTE

Some parts of pintle hook assembly may be replaced while assembly remains attached to vehicle. Refer to figure 2-231 and replace parts as required.

b. Disassembly.

(1) Remove locking pin (7) holding latch (3) in locked position.

(2) Remove cotter pin (15) from nut (14) and remove nut (14) from bolt (8). Remove lock (13) from assembly.

(3) to disassemble lock assembly, remove pin (5) securing latch (3) to lock and remove latch (3) and spring (4).

(4) Remove lube fittings (20, 9, and 6) from sleeve, bolt, and pin.

(5) Remove chain (10) from pin (7) and screw (11).

c. Assembly.

(1) Install spring (4) in lock (13) under latch (3). Aline holes in lock and latch and install new pin (5). Stake pin (5) to lock.

(2) Aline lock holes with holes in hook (12) and install bolt (8), nut (14), and cotter pin (15).

(3) Install screw (11) through end link of chain (10)

and install other end of chain in pin (7). Install screw (11) in hole in hook (12).

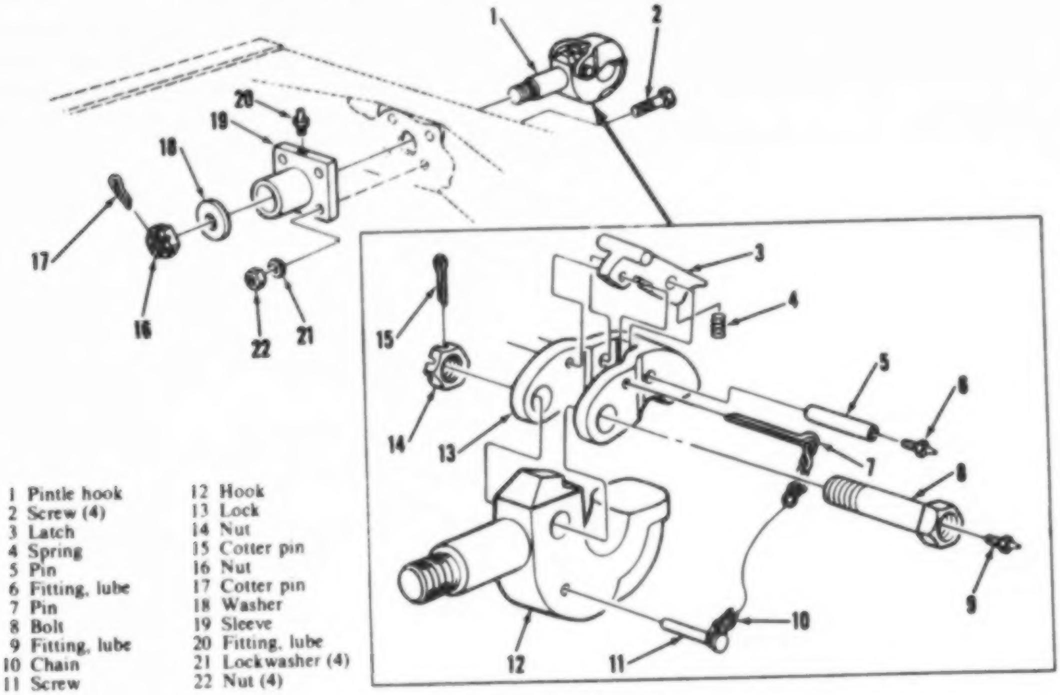
(4) Install fitting (9) in bolt head, and fitting (6) in pin (5). Install fitting (20) in sleeve (19).

d. Installation.

(1) Position sleeve (19) on inside of rear frame member and secure with four screws (2), lockwashers (21), and nuts (22). Tighten nuts to minimum 500 lb.-ft. torque.

(2) Insert pintle hook (1) through hole in frame member and sleeve and install washer (18), nut (16), and cotter pin (17).

(3) Add lubricant at all three fittings, following LO 9-2320-258-12.



1 Pintle hook
2 Screw (4)
3 Latch
4 Spring
5 Pin
6 Fitting, lube
7 Pin
8 Bolt
9 Fitting, lube
10 Chain
11 Screw
12 Hook
13 Lock
14 Nut
15 Cotter pin
16 Nut
17 Cotter pin
18 Washer
19 Sleeve
20 Fitting, lube
21 Lockwasher (4)
22 Nut (4)

TA027669

Figure 2-231. Towing pintle assembly—exploded view.

2-147. Engine Cover

Fig. 2-232

NOTE

For power plant removal, remove engine cover and support framework as an assembly. Unlatch and lift cover to remove support screws, then latch cover and remove assembly from vehicle.

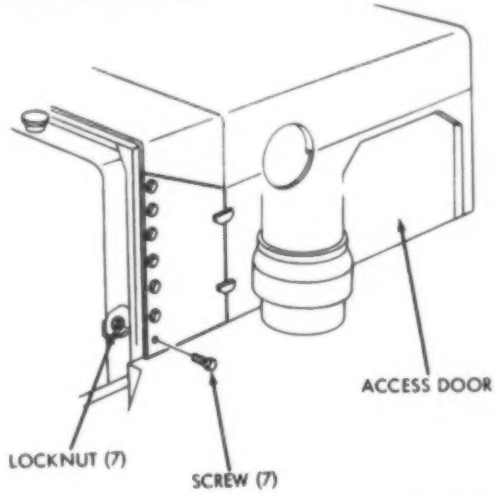
a. Replace Engine Cover. Unlatch engine cover. Remove four screws and washers that secure cover assembly at hinge channel to supports. Remove two nuts, washers, and screws securing end of each engine prop to cover. Remove engine cover from vehicle. For installation, place engine cover to vehicle and secure end of each engine prop to cover with two nuts, washers, and screws. Secure cover assembly at hinge channel to supports with four screws and washers. Latch engine cover.

b. Replace Cover Props.

NOTE

Always install cover props so that larger channel is on top.

Remove two nuts, washers, and screws securing each end of prop to cover or support and remove prop. To install position prop to cover or support by installing two screws, washers, and nuts.



TA027671

Figure 2-233. Removal or installation of side panels.

c. Replace Cover Supports. With cover removed, remove four screws and washers securing each support to shroud. Remove support. Attach and secure support to shroud with four screws and washers. Install cover.

2-148. Access Doors and Side Panels

a. Replace shroud access doors as required.

b. Replace shroud forward side panels as follows: Unlatch side panel. Remove seven screws and locknuts securing side panel to radiator shroud. Remove side panel. Install in reverse manner of removal.

2-149. Trailer Air Coupling Support Brackets

No repair is authorized. Replace mounting hardware as required.

2-150. Fuel Tank Support

Fig. 2-234

a. Removal. Remove fuel tank from vehicle (para 2-42*b*). Disconnect air lines from fittings on air tank. Block up fuel tank support and remove 12 nuts and screws securing support to frame. Lower tank support to ground. Remove air tanks and air line, fittings, and drain cock from support (para 2-125).

b. Installation. Attach air tanks and air line, fittings, and drain cock to support. Position tank support to frame and secure with 12 nuts and screws. Connect air lines to fittings on air tank and assemble fuel tank to vehicle.

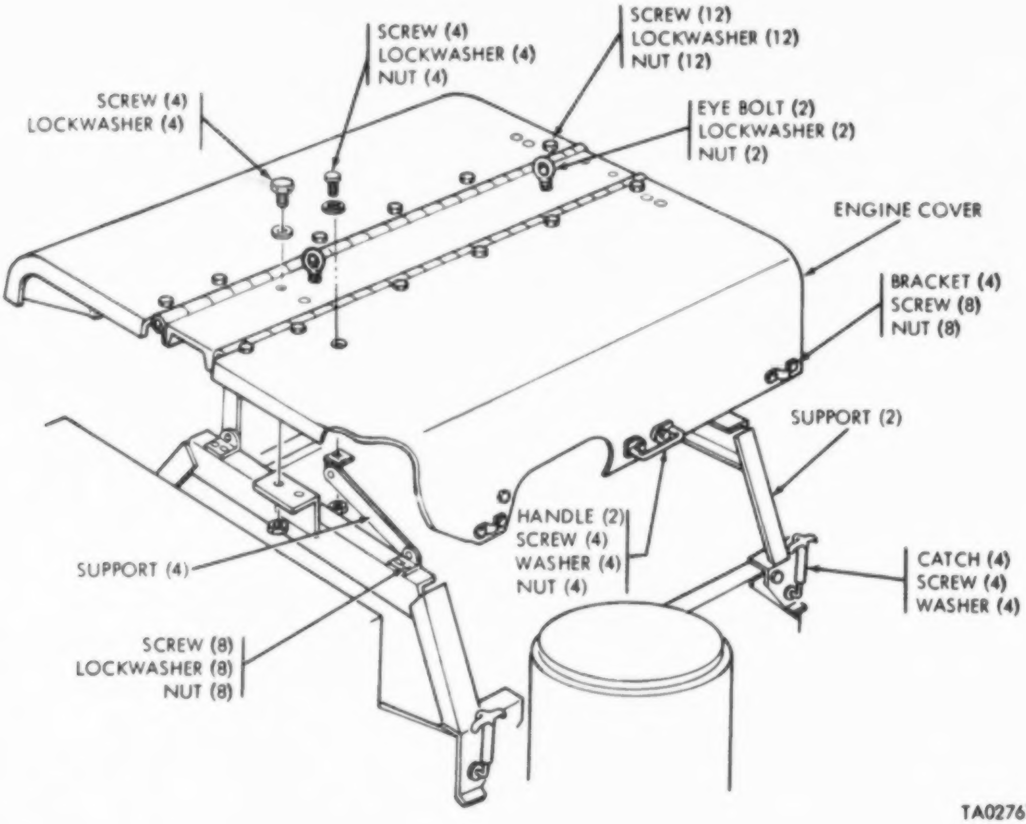

SCREW (4)
LOCKWASHER (4)
NUT (4)
SCREW (12)
LOCKWASHER (12)
NUT (12)
SCREW (4)
LOCKWASHER (4)
EYE BOLT (2)
LOCKWASHER (2)
NUT (2)
ENGINE COVER
BRACKET (4)
SCREW (8)
NUT (8)
SUPPORT (2)
HANDLE (2)
SCREW (4)
WASHER (4)
NUT (4)
SUPPORT (4)
CATCH (4)
SCREW (4)
WASHER (4)
SCREW (8)
LOCKWASHER (8)
NUT (8)
TA027670

Figure 2-232. Removal or installation of engine cover.

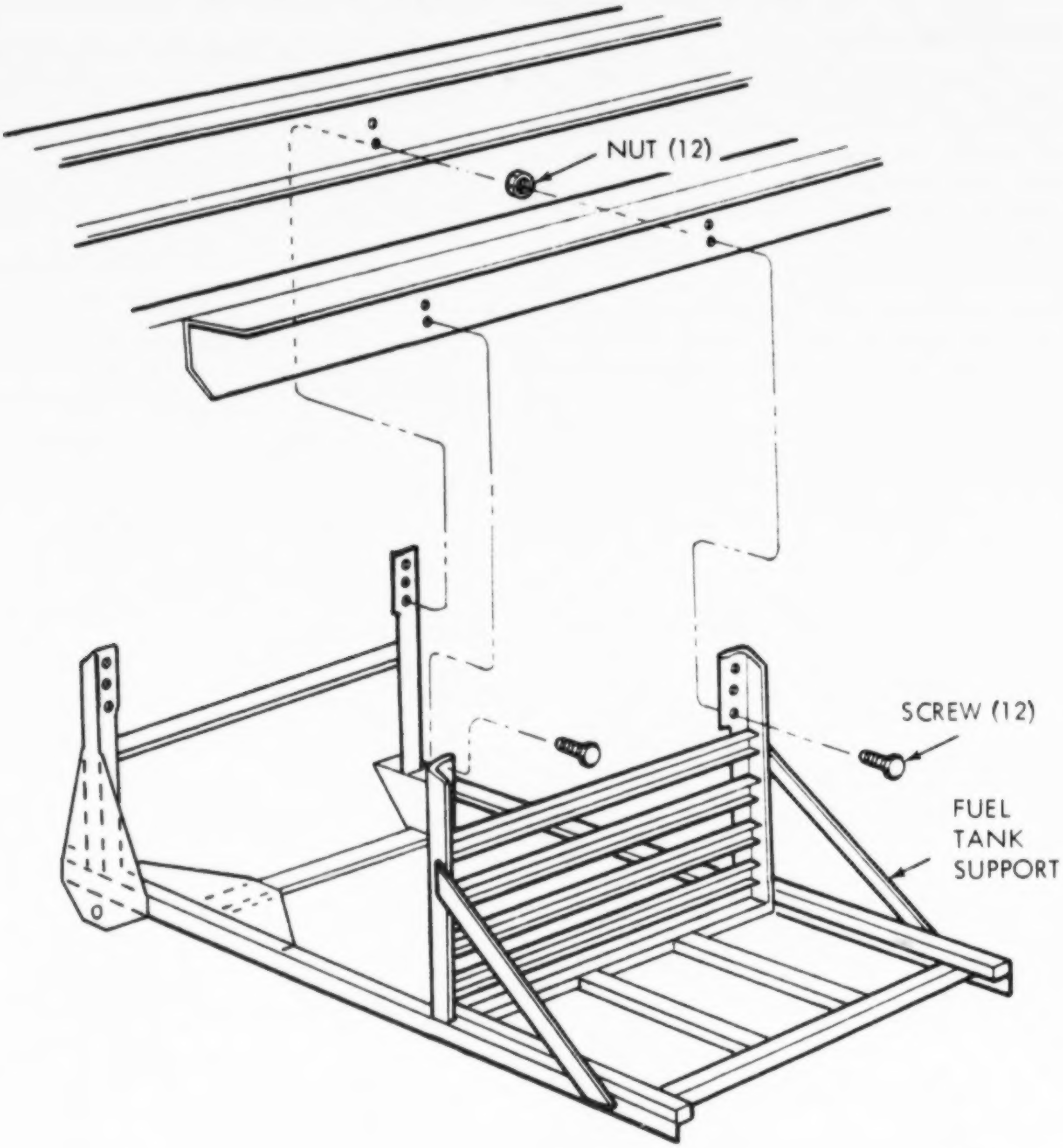

NUT (12)
SCREW (12)
FUEL
TANK
SUPPORT
TA027672

Figure 2-234. Removal or installation of fuel tank support.

Section XXV. CAB AND BODY COMPONENTS

2-151. Description

a. General. The M746 tractor cab is of steel and fiberglass construction, with a removeable fiberglass hardtop. The two-section windshield can be folded down or removed. The doors have rolldown type windows. A door is provided at front of cab to allow access to equipment mounted beneath or in back of the cab dash panel. Two steps on each side of the cab permit access to the cab or to the forward deck. The cab is provided with three personnel seat assemblies, a battery box, a personnel heter compartment, and instruments and controls required to operate the vehicle. The cab is secured to the front bumper and to the forward decking on cushion type mounts.

b. Cab Top. The fiberglass cab top is provided with seals that protect the cab from water leaks and dampen vibration during travel. The cab has two rear windows which are secured by the locking type rubber molding. A circular platform is provided in the cab top for possible future installation of an air defense weapon. The cab top is secured to the cab rear wall and windshield by mounting bolts.

c. Windshield. The two-section windshield is secured by hinges and screws to the cab. Each window is secured in the windshield frame by the locking type molding. The windshield is supported and sealed at the center by a removeable center post assembly which nests in a tube provided in the dash panel and latches to the windshield.

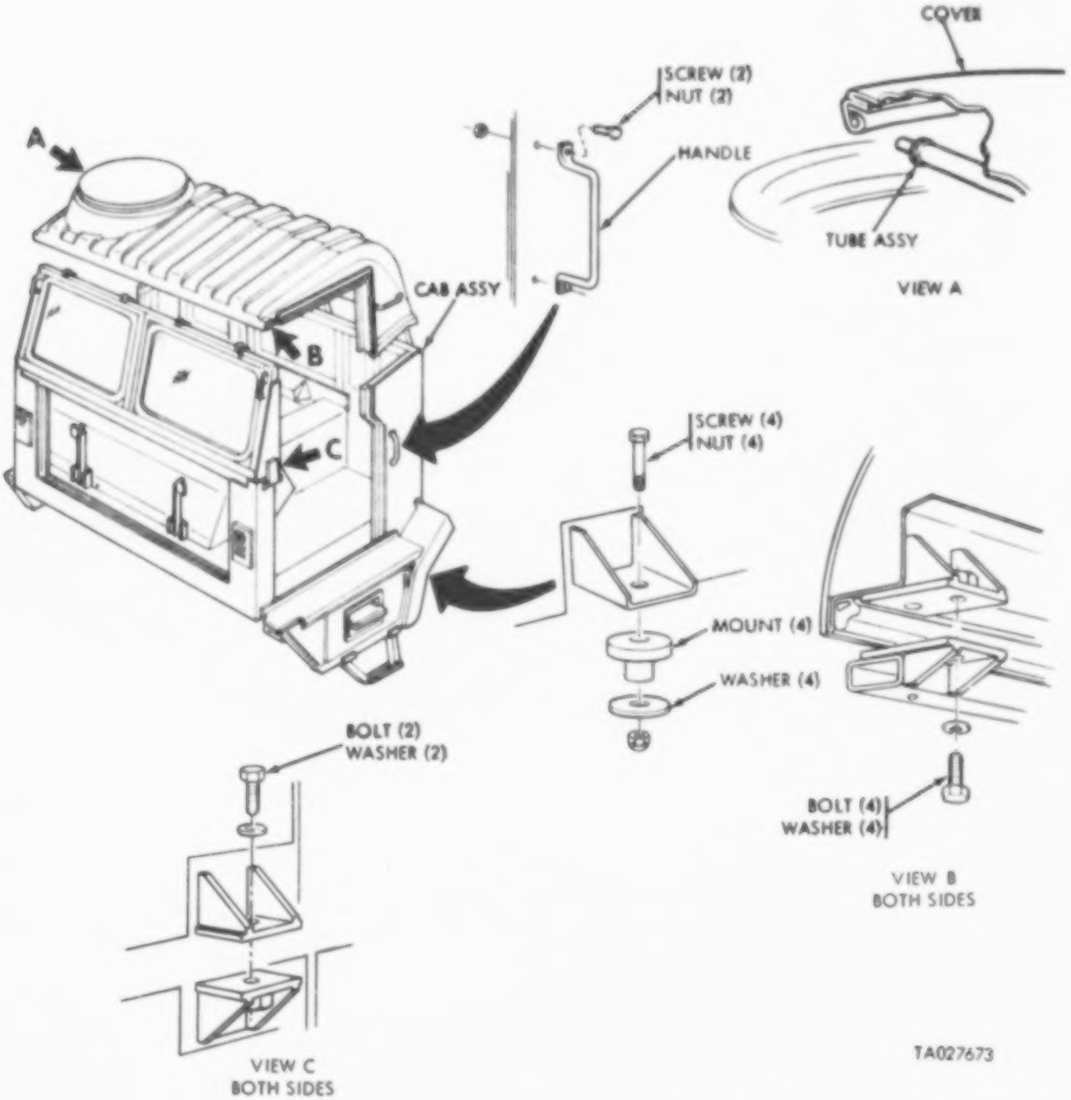


Figure 2-235. Cab top and cab attachment.

d. Cab Front Access Door. The cab front access door is hinged at the top and is supported by two supports when the door is open. The front access door closes against weather strips that are bonded to the cab framework.

e. Cab Doors. The two cab doors are secured on hinges mounted to the cab framework by screws. Door closure is sealed by weatherstripping. A mirror and mirror support assembly is provided on each door. The door lock operates by positioning the inside handle only so that the door cannot be opened or closed from the outside. A catch on the cab door frame is adjusted by shims to a position that prevents the door lock from applying when the door is shut from the outside. Thus, the operator cannot lock himself out.

2-152. Cab Top

Figs. 2-235 and 2-236

a. Removal of Cab Top (fig. 2-235). Disconnect two bolts and washers securing front of cab top to windshield.

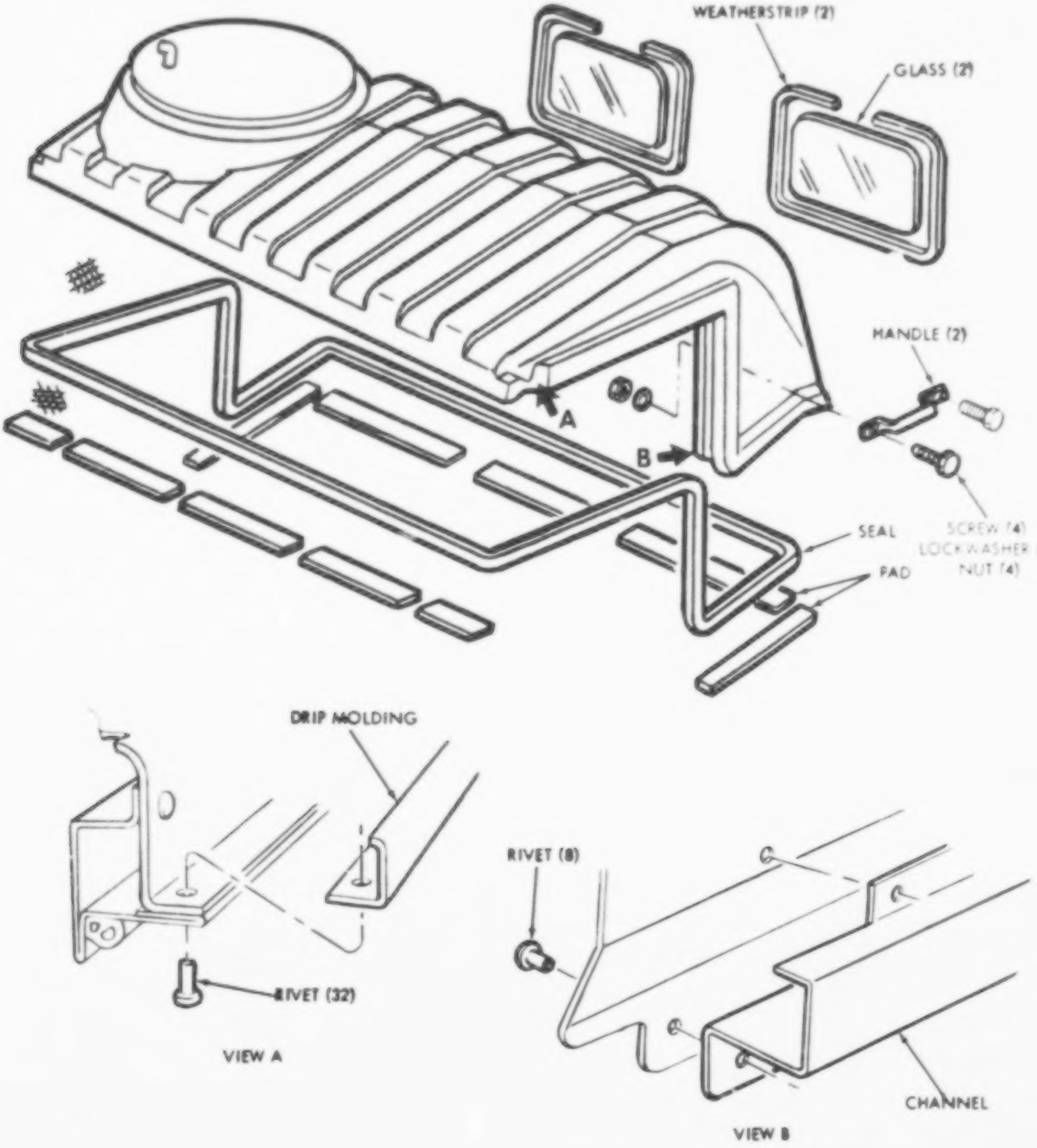

WEATHERSTRIP (2)
GLASS (2)
HANDLE (2)
A
B
SEAL
PAD
SCREW (4)
LOCKWASHER (4)
NUT (4)
DRIP MOLDING
RIVET (32)
VIEW A
RIVET (8)
CHANNEL
VIEW B

Figure 2-236. Cab top seals.

TA027674

Disconnect four bolts and washers securing rear of cab top to cab. Lift cab top straight up until it is clear of bolt heads on windshield and cab rear wall, and remove cab top from vehicle.

b. Installation of Cab Top. Secure cab top to vehicle by lowering cab straight down and clearing bolt heads on windshield and cab rear wall. Connect four bolts and washers securing rear of cab top to cab. Connect two bolts and washers securing front of cab top to windshield.

c. Installation of Cab Top Seals (Fig. 2-236).

(1) Remove old seal from cab top. Remove old adhesive using suitable solvent.

(2) Cut pad type seals to lengths required. Cut weatherstrip seal to approximately 340 inches then trim as required.

(3) Bond seals to cab using adhesive type II, spec MIL-A-5092.

d. Installation of Cab Top Windows. Remove and install rear windows using same procedure as for windshield windows (para 2-153*c*). Install weatherstrip with lock portion facing outside of cab.

2-153. Windshield

Figs. 2-237 through 2-239

NOTE

Cab top must be removed before removing windshield.

a. Replacement of Windshield (Fig. 2-237). Unscrew windshield mounting bolts at side attach angles. Remove two screws securing each of two hinges to windshield section. Unlatch windshield section at center support. Remove windshield section. Repeat for other windshield section. Install both windshield sections by latching windshield section at center support. Secure each of two hinges to windshield section with two screws. Tighten windshield mounting bolts at side attach angles.

b. Replacement of Windshield Hinges, Seals, and Center Support.

(1) Remove and install four hinges using four screws for each hinge.

(2) Replace seals on windshield and center support by removing old seal, removing old adhesive with suitable solvent, and bonding new seal in place using adhesive type II, spec MIL-A-5092.

(3) Replace center support and latch assembly (fig. 2-238) as required. Replace windshield side attach bolts (fig. 2-235) by removing one bolt and washer on each side.

(4) Replace windshield down-position pin bracket, pin, or retaining wire as required.

c. Replacement of Glass (Fig. 2-239).

(1) *Removal.* With hooked end of tool CPR-109701, unlock weatherstrip lock by running hook between lock and lock groove. Pry weather strip away from glass at one point and hold glass in fingers. Run finger a-

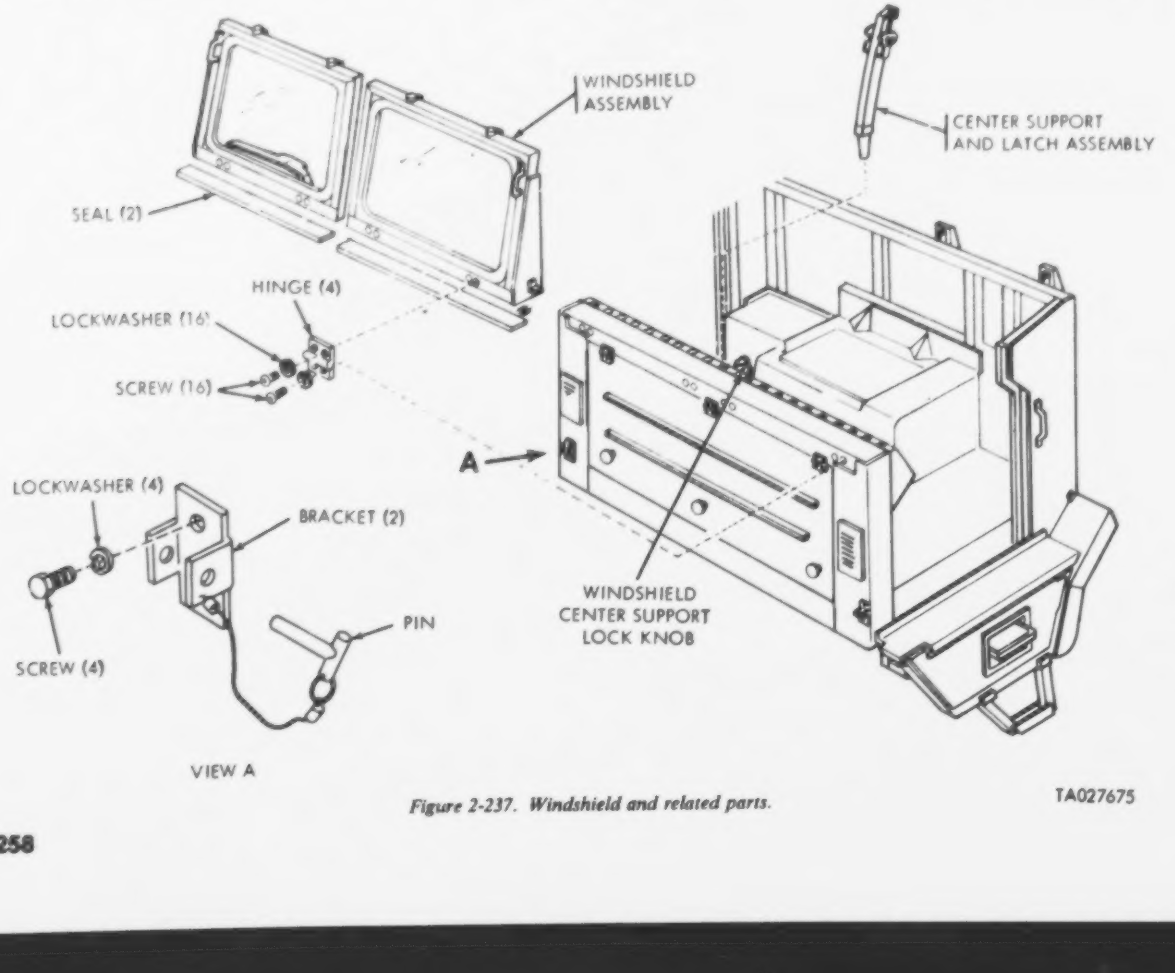


Figure 2-237. Windshield and related parts.

TA027675

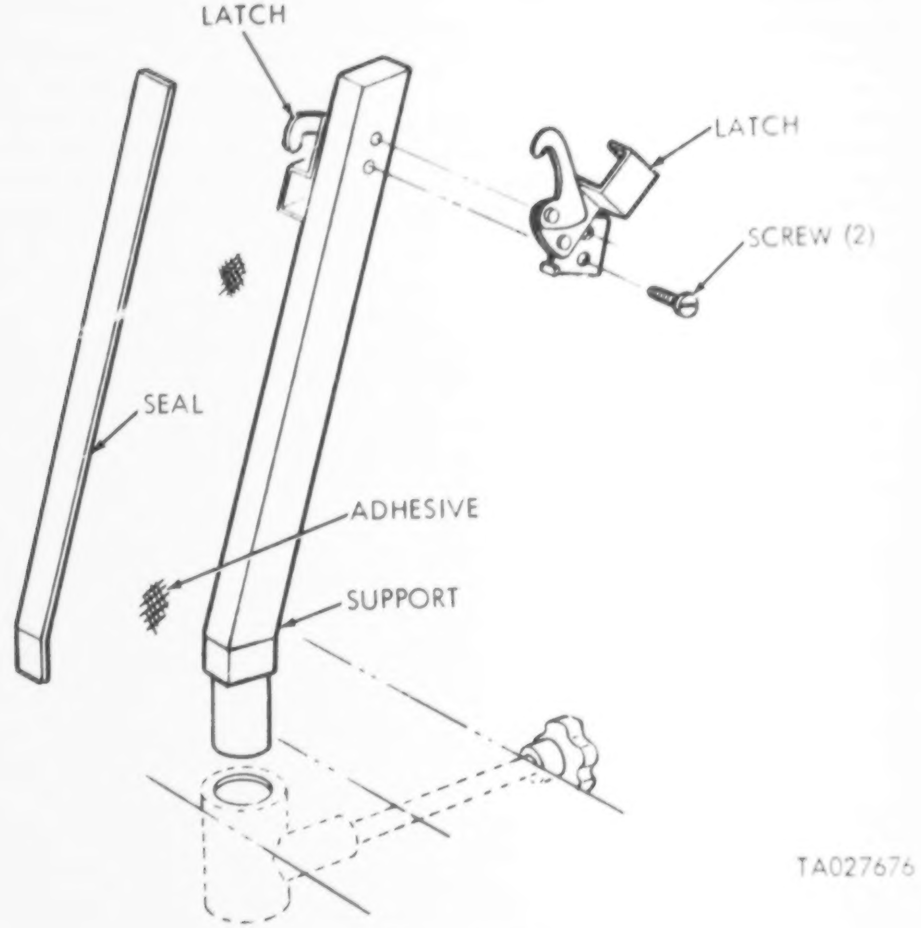

LATCH
LATCH
SCREW (2)
SEAL
ADHESIVE
SUPPORT
TA027676

Figure 2-238. Windshield center support and related parts.

long weatherstrip while pulling on glass to disengage glass from weatherstrip. Remove glass.

(2) *Installation.* Position weatherstrip on window frame with lock portion facing inside of cab, small groove over frame channel (step 1). Insert glass in large groove of weatherstrip at bottom of window frame and work weatherstrip with fingers around glass until glass is secured in large groove (step 2). Push lock of weatherstrip into lock groove at one point with straight end of tool CPR-109701. Then run tool around entire lock length pushing lock into groove so that glass is secured (step 3).

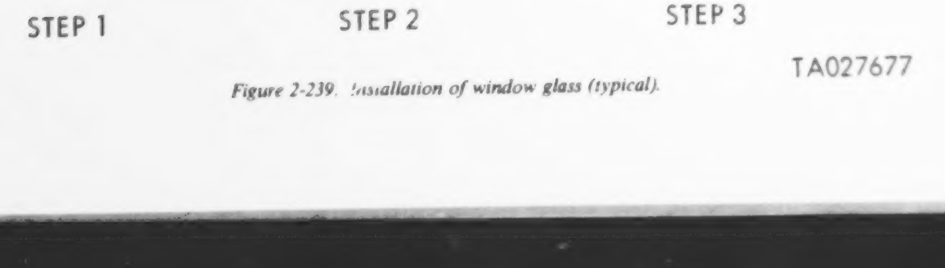

FRAME
GLASS
WEATHERSTRIP UNLOCKED
WEATHERSTRIP LOCKED
STEP 1
STEP 2
STEP 3
TA027677

Figure 2-239. Installation of window glass (typical).

2-154. Cab Front Access Door and Related Parts

Fig. 2-240

a. Removal of Door. Open door and remove two screws and locknuts securing end of each door support. Close door and lock center handle. Remove two screws securing each of three hinges to door. Support door to prevent door from falling and open center handle. Remove door.

b. Installation of Door. Position door with support to prevent door from falling and close center handle. Attach two screws securing each of three hinges to door. Open door and unlock center handle. Attach two screws and locknuts securing end of each door support.

c. Replacement of Door Supports

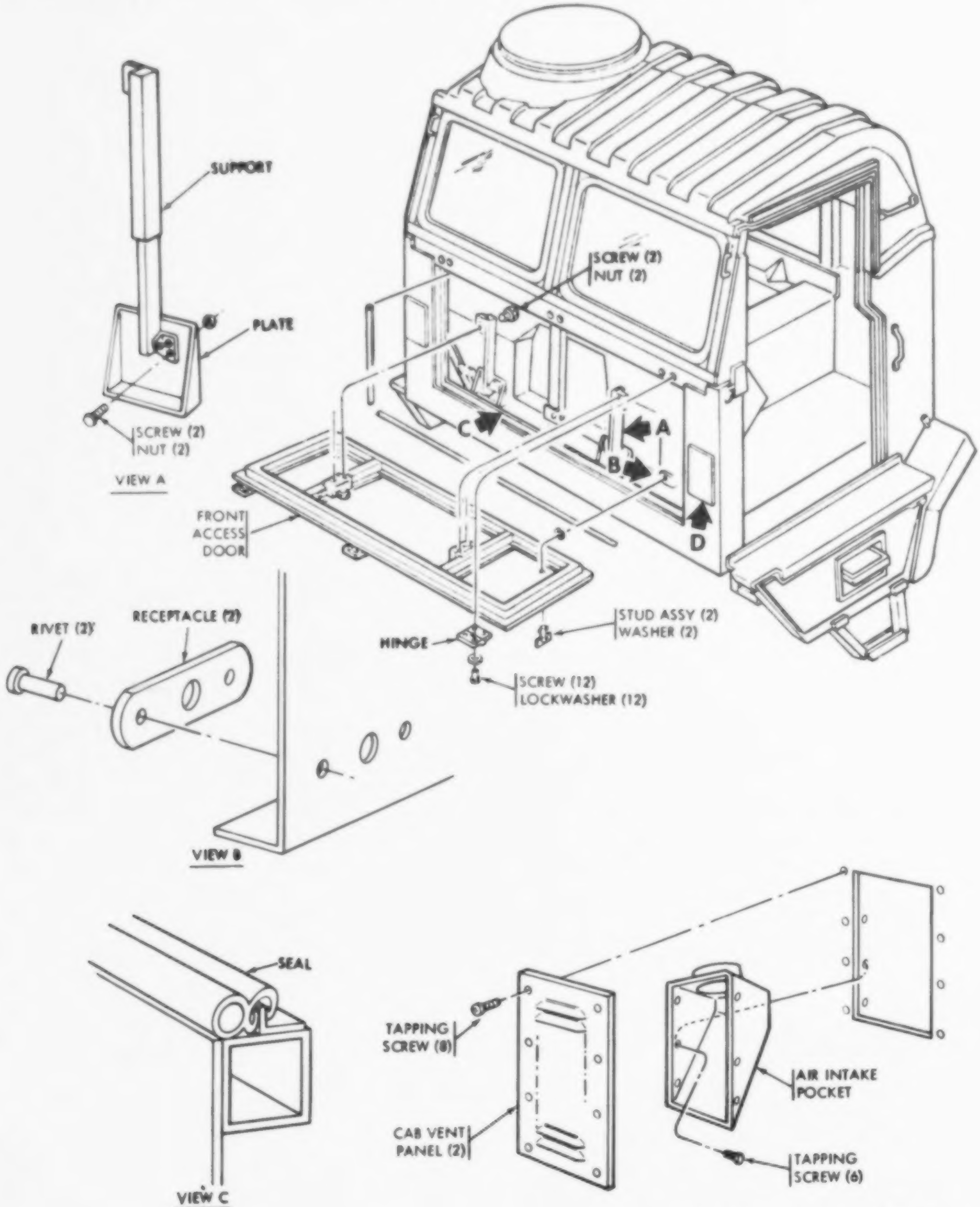

SUPPORT
PLATE
SCREW (2)
NUT (2)
VIEW A
SCREW (2)
NUT (2)
C
A
B
D
FRONT ACCESS DOOR
STUD ASSY (2)
WASHER (2)
HINGE
SCREW (12)
LOCKWASHER (12)
RIVET (2)
RECEPTACLE (2)
VIEW B
SEAL
VIEW C
TAPPING SCREW (8)
CAB VENT PANEL (2)
AIR INTAKE POCKET
TAPPING SCREW (6)
VIEW D
TA027678

Figure 2-240. Cab front access door and related parts.

NOTE

Supports must be installed with large channel on top.

Remove four screws and locknuts securing door support to mounting plate on cab. Remove support. Install support using four screws and locknuts (inset, fig. 2-240).

d. Replacement of Door Seal. Remove old seals. Remove old adhesive using suitable solvent. Cut two each of two lengths of seals to fit channel in cab front door frame. Bond seals to channel using adhesive type II, spec MIL-A-9052.

e. Replacement of Door Handles. Pull handle straight out from door after cross pin on handle is alined with slot in door. Align cross pin on handle with slot in door and push handle straight into door.

f. Replacement of Door Latch Receptacle. Remove two rivets from receptacle. Remove receptacle and replace. Replace rivets.

g. Replacement of Cab Vent Panel and Air Intake Pocket. Remove six tapping screws securing vent panel. Remove six tapping screws securing air intake pocket. Install air intake pocket using six tapping screws. Install cab vent panel using six tapping screws.

2-155. Cab Door Assembly

Fig. 2-241

a. Removal of Door. Remove mirror support assembly from door. Open door and remove six screws securing door hinges to cab door frame. Remove door.

b. Repairing Door. Replace door sash assembly, seals, window regulator, door lock, handles, or other parts as required. Refer to figure 2-230 for identification of parts. Use adhesive type II, spec MIL-A-5092 to bond seals in place.

c. Installation of Door. Position door and attach six screws securing door hinges to cab door frame. Close door and assemble mirror support assembly to door. Check operation of door lock release catch after new door is installed. If door locks when closed from outside vehicle, shim up catch until door lock releases when door is closed from outside (*d* below).

d. Replacement of Door Lock Release Catch. Remove two screws securing catch to cab door frame. Remove catch, plate, and/or shims. Install new catch. Adjust catch standout with plate and/or shims so that door lock releases when door is closed from outside vehicle. Open door window. Open door and put door lock handle in closed position. Close door slowly from outside vehicle. Observe that catch interrupts locks and begins pushing lock back. Close door all the way. If door will not reopen, add additional shims behind catch.

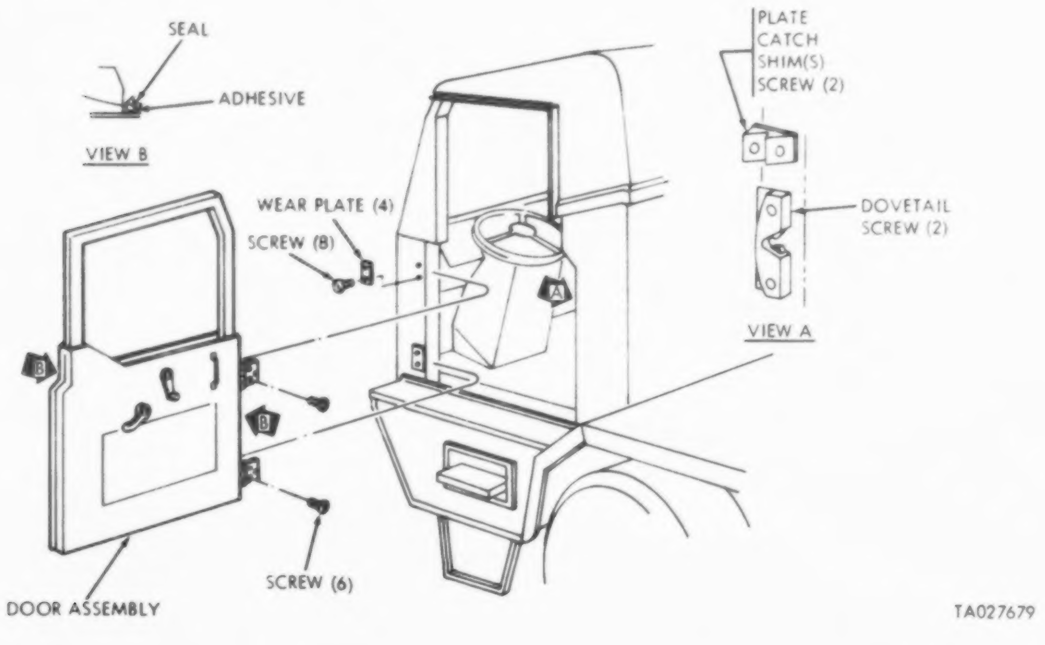
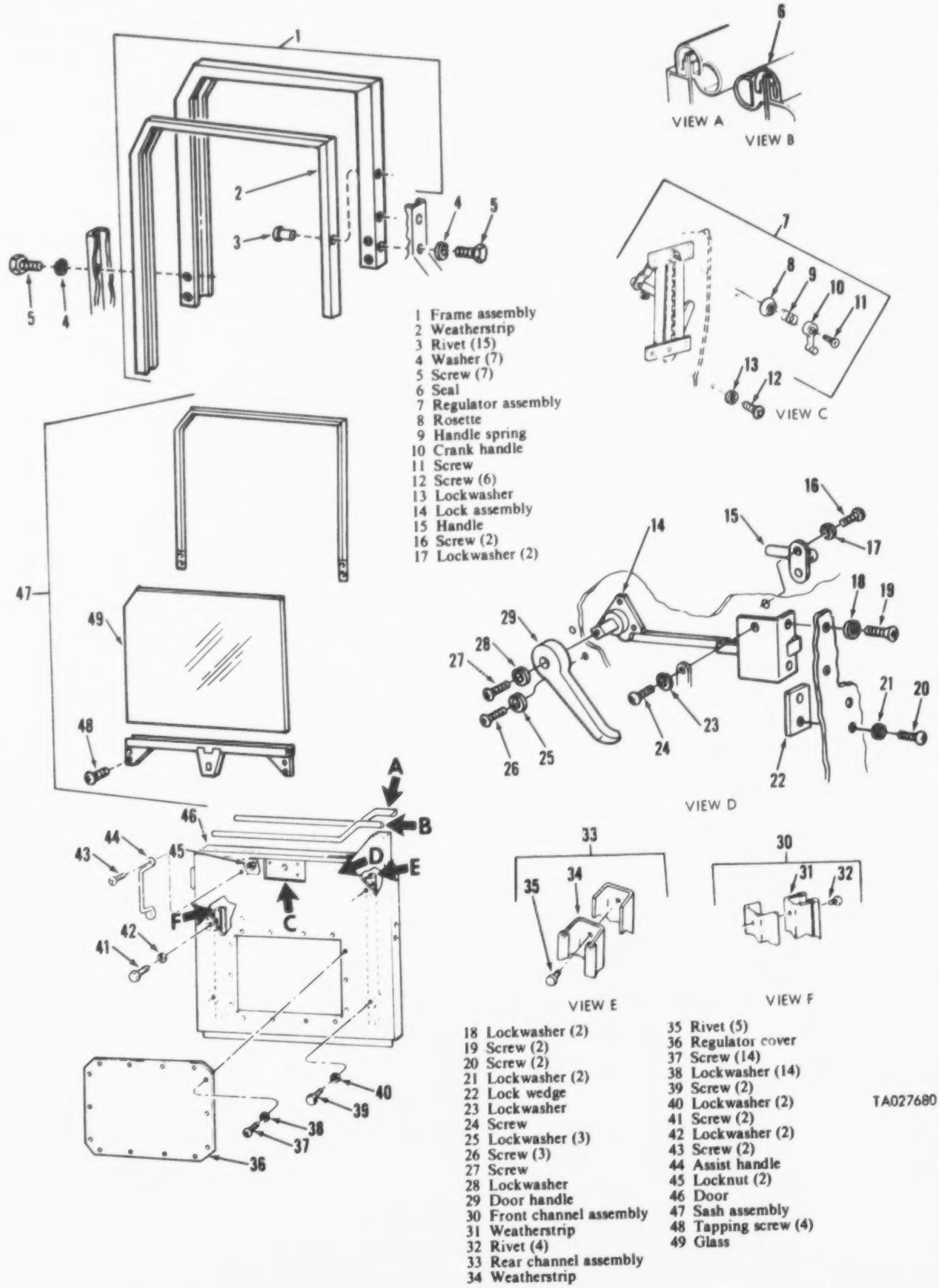


Figure 2-241. Removal or installation of door assembly and related parts.



1 Frame assembly
2 Weatherstrip
3 Rivet (15)
4 Washer (7)
5 Screw (7)
6 Seal
7 Regulator assembly
8 Rosette
9 Handle spring
10 Crank handle
11 Screw
12 Screw (6)
13 Lockwasher
14 Lock assembly
15 Handle
16 Screw (2)
17 Lockwasher (2)

18 Lockwasher (2)
19 Screw (2)
20 Screw (2)
21 Lockwasher (2)
22 Lock wedge
23 Lockwasher
24 Screw
25 Lockwasher (3)
26 Screw (3)
27 Screw
28 Lockwasher
29 Door handle
30 Front channel assembly
31 Weatherstrip
32 Rivet (4)
33 Rear channel assembly
34 Weatherstrip

35 Rivet (5)
36 Regulator cover
37 Screw (14)
38 Lockwasher (14)
39 Screw (2)
40 Lockwasher (2)
41 Screw (2)
42 Lockwasher (2)
43 Screw (2)
44 Assist handle
45 Locknut (2)
46 Door
47 Sash assembly
48 Tapping screw (4)
49 Glass

Figure 2-242. Door assembly—exploded view.

2-156. Cab Steps

Fig 2-243

Refer to figure 2-243 and remove and replace cab steps as required.

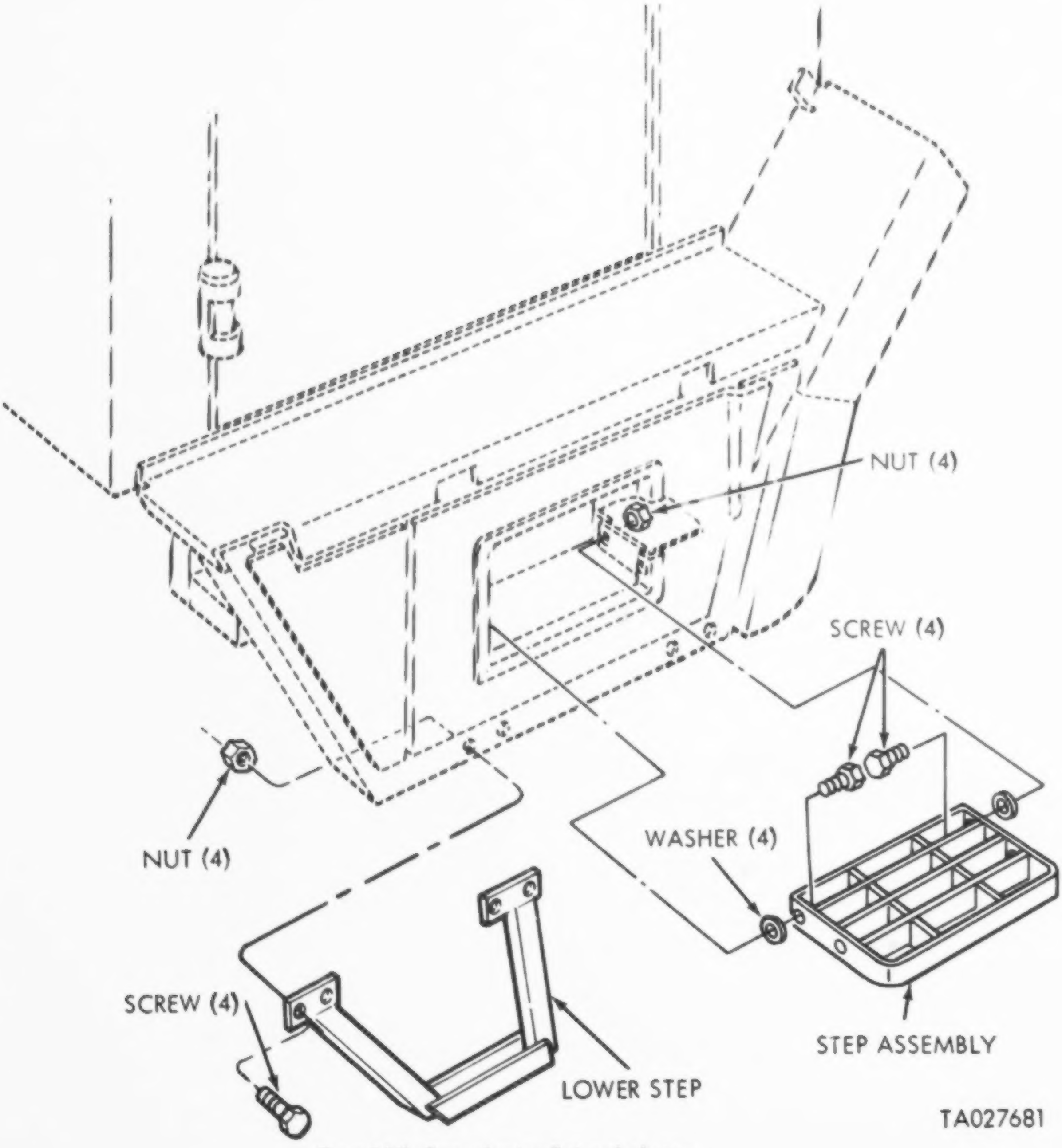

NUT (4)
SCREW (4)
NUT (4)
WASHER (4)
SCREW (4)
STEP ASSEMBLY
LOWER STEP
TA027681

Figure 2-243. Removal or installation of cab steps.

2-157. Cab Mounts

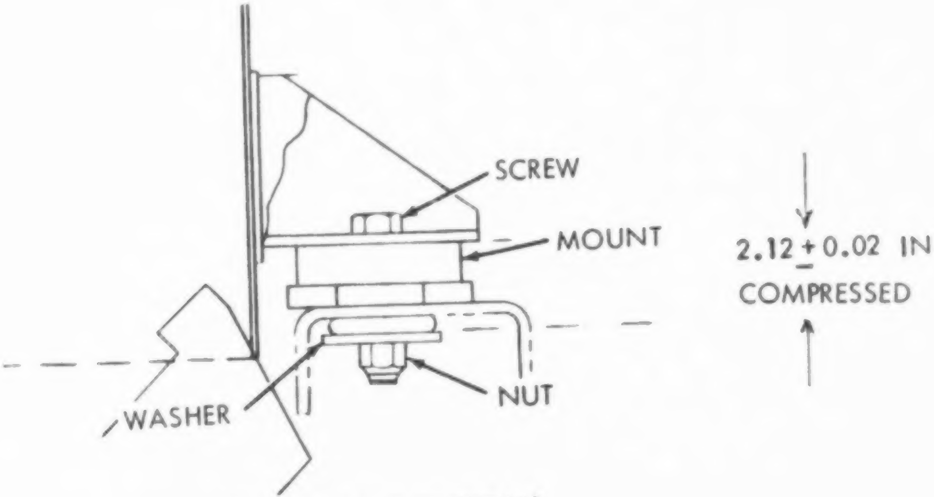
Fig. 2-244

NOTE

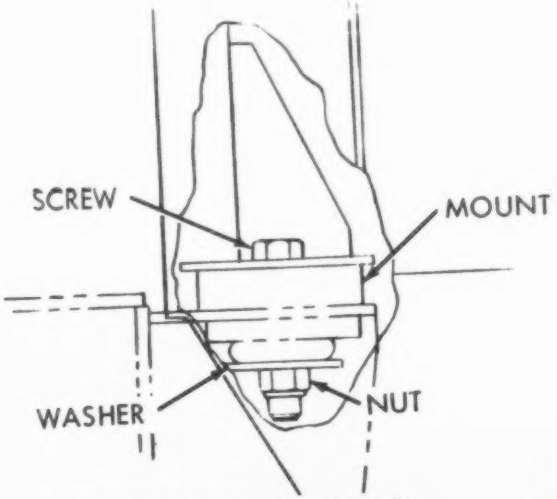
Cab mounts may be replaced without removing cab or cab mounted components.

a. Removal. If all four mounts are to be replaced, remove all four nuts. If one mount is to be replaced, remove nuts from both mount screws on the side where replacement is intended, and loosen remaining two nuts. Remove screws with washers from which nuts were removed. Pry or jack the cab upwards just enough to remove mount(s). Remove mount(s).

b. Installation. With cab pryed or jacked upward at one end, lubricate mount with water or rubber lubricant and insert rubber mount(s) through hole in bumper bracket or bracket on deck framework. Lower cab. Install screws, washers, and nuts. Tighten all nuts until compression distance between washer and attach angle is 2.12 ± 0.02 inches.



A. REAR MOUNT (TYPICAL)



B. FRONT MOUNT (TYPICAL)

TA027682

Figure 2-244. Cab mounts

2-158. Mirrors and Mirror Support

a. Remove and install mirror and mirror support assembly (fig. 2-245 and 2-246).

NOTE

Mirror support assembly may be removed in two ways. Either the knurled knobs (fig. 2-245) may be removed, the wing nut loosened, and one tubular rod sprung away from the door bracket screw that holds it, to remove support, or the following procedures may be employed.

(1) *Removal.* Remove four screws and lockwashers securing lower mirror support door bracket to door. Prevent mirror support from falling and remove two screws and lockwashers securing each upper mirror support door bracket to door. Remove support assembly.

(2) *Installation.* Position support assembly. Attach two screws and lockwashers securing each upper mirror support door bracket to door. Attach four screws and lockwashers to secure lower mirror support door bracket to door.

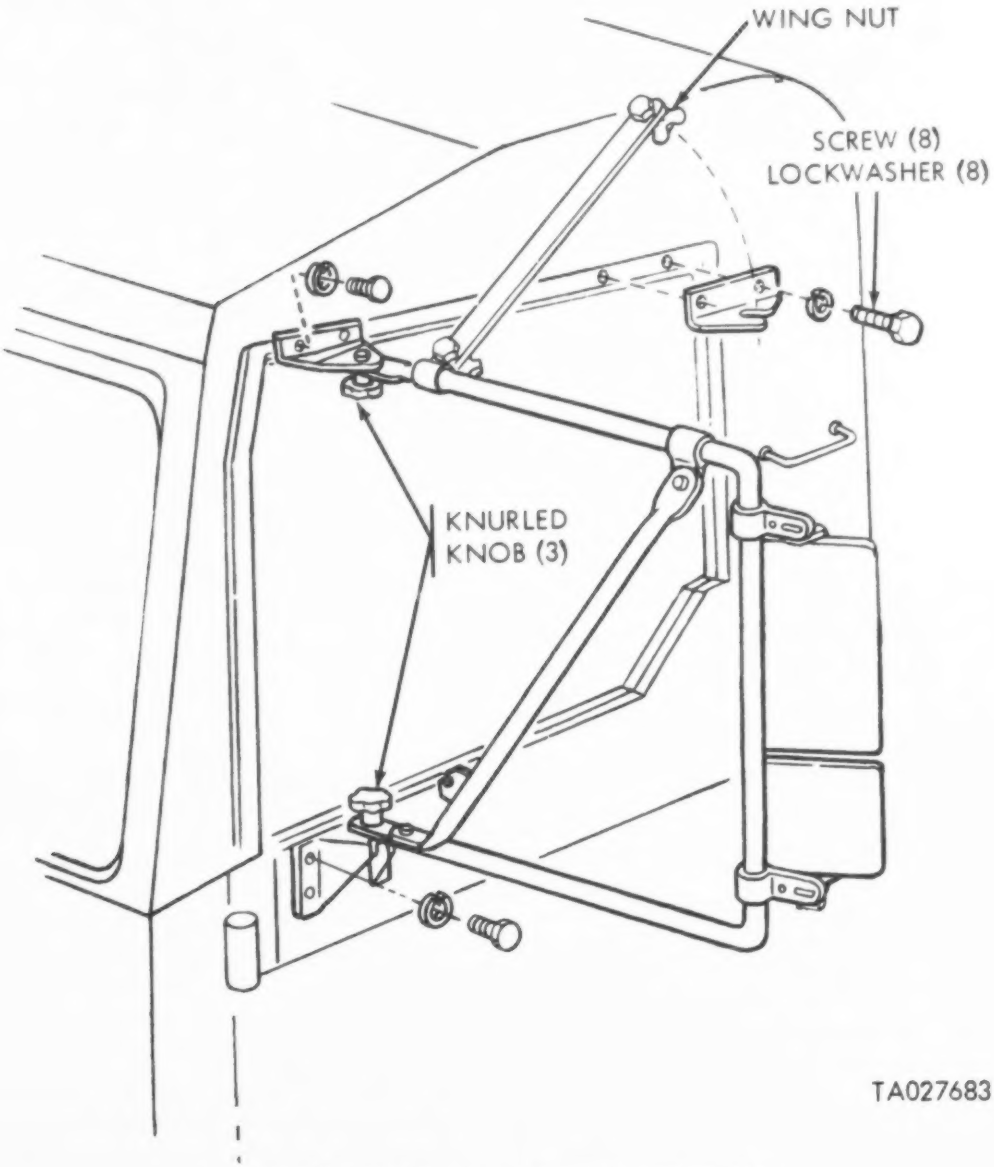


Figure 2-24[illegible] Removal or installation of mirror support assembly.

b. Replacement of Mirror (fig. 2-246).

(1) *Removal.* Remove nut on each end of mirror. Remove nut on screw securing top slotted support bracket to top clamp. Hold mirror and remove screw and slotted support bracket. Remove mirror.

(2) *Installation.* Position mirror and secure by attaching screw and slotted support bracket. Attach nut on screw which secures top slotted support bracket to top clamp. Attach nut on each end of mirror.

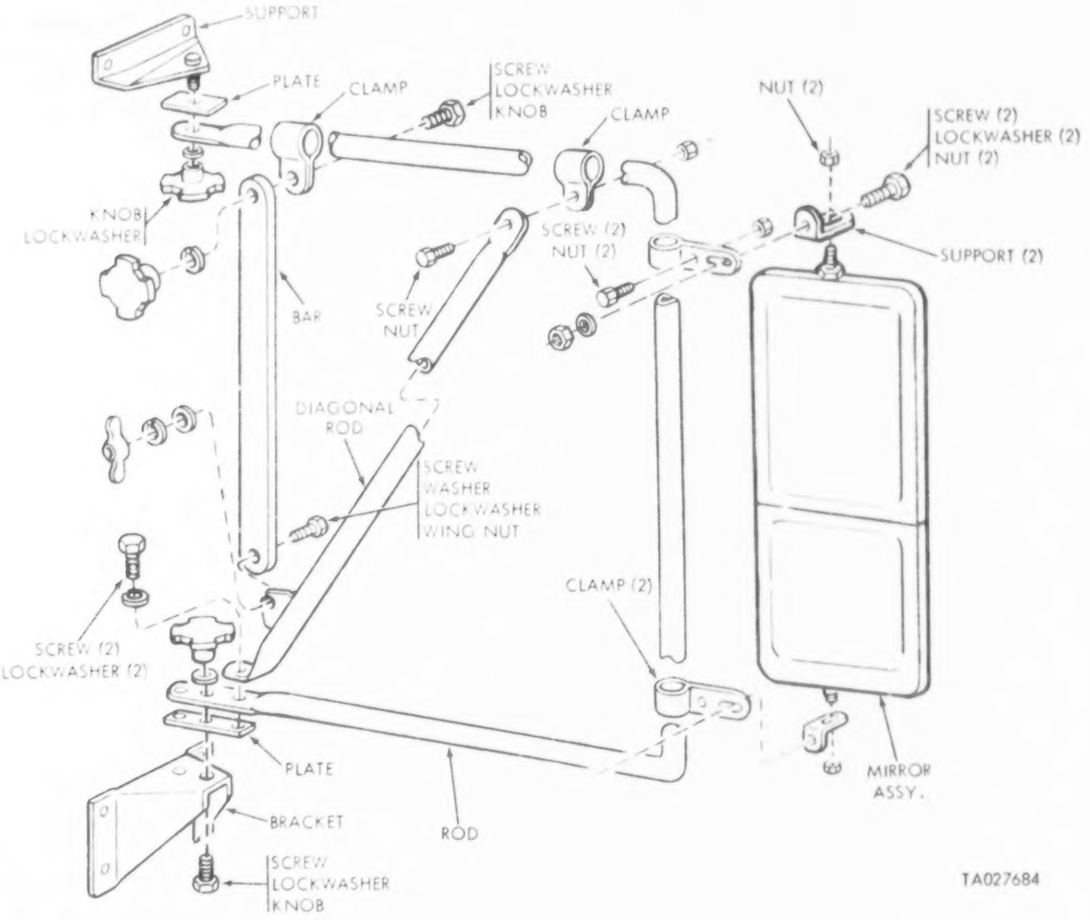

SUPPORT
PLATE
CLAMP
SCREW
LOCKWASHER
KNOB
CLAMP
NUT (2)
SCREW (2)
LOCKWASHER (2)
NUT (2)
KNOB
LOCKWASHER
SCREW (2)
NUT (2)
SUPPORT (2)
SCREW
NUT
BAR
DIAGONAL ROD
SCREW
WASHER
LOCKWASHER
WING NUT
CLAMP (2)
SCREW (2)
LOCKWASHER (2)
PLATE
MIRROR ASSY.
BRACKET
ROD
SCREW
LOCKWASHER
KNOB
TA027684

Figure 2-246. Mirror and mirror support assembly — exploded view.

c. Repair Mirror Support Assembly. Refer to figure 2-246 and replace parts of support assembly as required.

2-159. Sun Visor Fig. 2-247

a. Removal. Remove two screws, nuts, and spacer securing visor mounting bracket to windshield frame. Remove visor. Remove two screws, nuts, and spacer securing visor clip bracket. Remove data plates from visor.

b. Adjustment.

NOTE

> When new visor is installed, remove clamp screw from visor clamp and add washers for adjustment.

Remove visor clamp screw. Insert washer(s) on clamp screw. Insert washer(s) in clamp slot. Install clamp screw. Turn visor in clamp. If visor pivot is too loose, remove washer(s) as required from clamp slot. If visor pivot is too tight, add washer(s) to clamp slot. Install extra washers at cap end of clamp screw.

c. Installation. Position visor on windshield frame. Install two screws, spacer, and two nuts from mounting bracket to windshield frame. Install clip bracket using two screws, nuts, and spacer. Install data plates on visor (para 2-164*i*).

2-160. Cab Utility Compartment Door

Fig. 2-248

Replace latch, hasp, lock keeper, or clamp as required. After installing new latch assembly, turn knob right or left to adjust for proper closure.

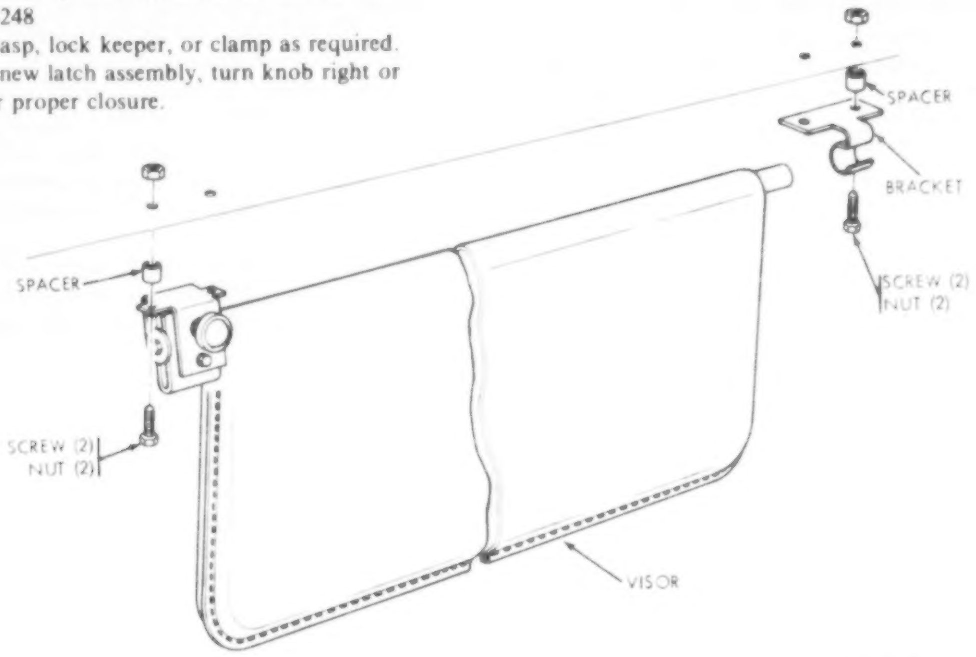

SPACER
BRACKET
SCREW (2)
NUT (2)
SPACER
SCREW (2)
NUT (2)
VISOR
TA027685

Figure 2-247. Removal or installation of sun visor.

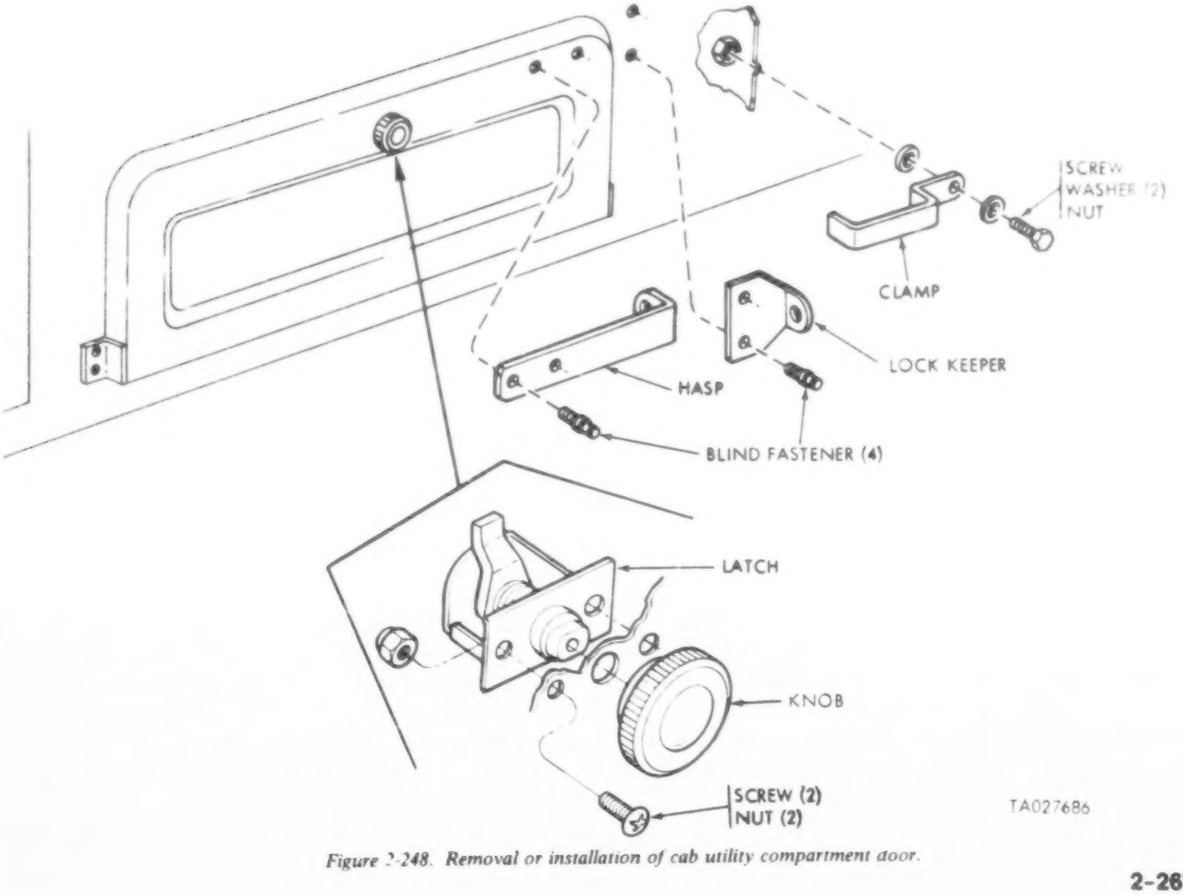

SCREW
WASHER (2)
NUT
CLAMP
LOCK KEEPER
HASP
BLIND FASTENER (4)
LATCH
KNOB
SCREW (2)
NUT (2)
TA027686

Figure 2-248. Removal or installation of cab utility compartment door.

2-161. Cab Seat Assemblies

a. Replace Driver's Seat (fig. 2-249).

(1) *Removal.* Remove four screws and lockwashers securing seat base to platform assembly. Remove seat assembly. If seat platform is damaged, remove six screws and nuts securing platform to cab floor and remove platform.

(2) *Installation.* To replace platform, attach six screws and nuts to secure platform to cab floor. Position seat assembly by attaching four screws and lockwashers to secure seat base to platform assembly.

b. Repair Driver's Seat (fig. 2-250).

(1) *Disassembly.* Remove two nuts from each of the two adjuster assemblies. Remove each adjuster from the base assembly by removing two nuts. Replace adjuster or base assembly as required.

(2) *Assembly.* Secure each adjuster to the base assembly by attaching two nuts. Attach two nuts to each of the two adjuster assemblies to secure seat.

c. Replace Driver's Seat Belts (fig. 2-249).

(1) *Removal.* Remove screw, self-locking nuts, and plain nut securing each end of driver's seat belt to seat frame. Remove screw and nut retaining drivers rear seat belt to rear of cab.

(2) *Installation.* Attach screw and nut to retain drivers rear seat to rear of cab. Secure each end of driver's belt to seat frame by attaching screw, self-locking nuts, and plain nut.

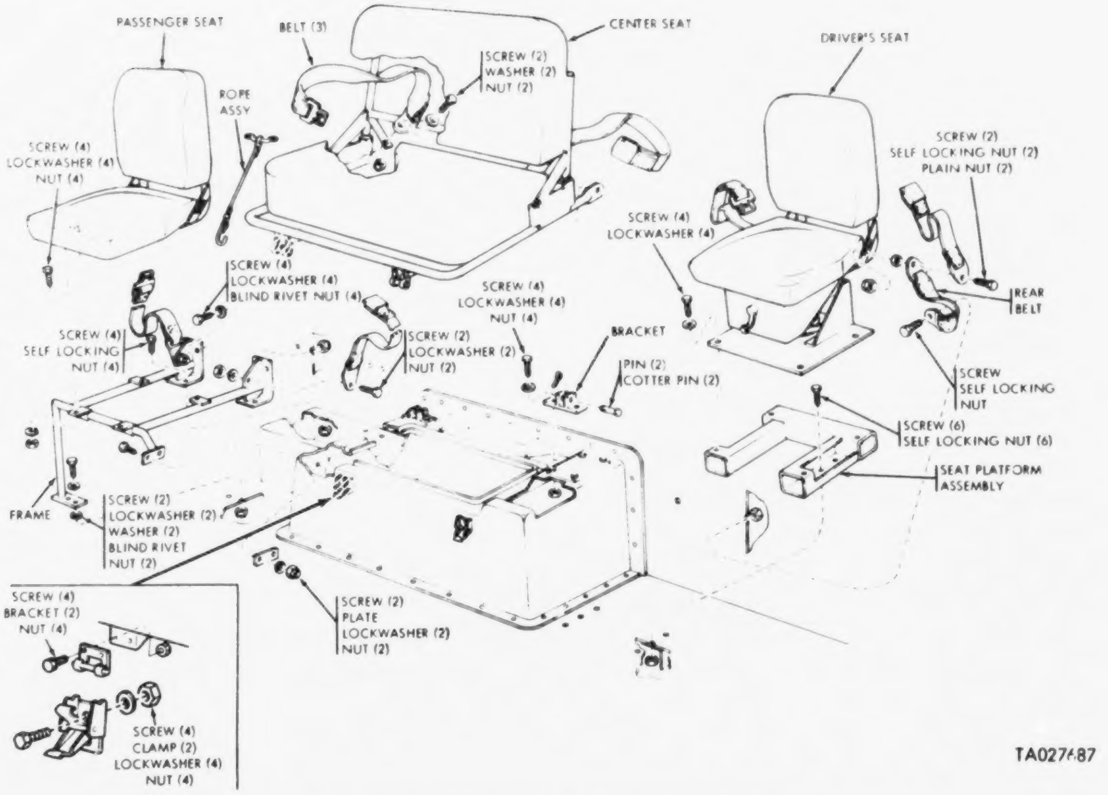

PASSENGER SEAT
BELT (3)
CENTER SEAT
SCREW (2)
WASHER (2)
NUT (2)
ROPE ASSY
DRIVER'S SEAT
SCREW (4)
LOCKWASHER (4)
NUT (4)
SCREW (2)
SELF LOCKING NUT (2)
PLAIN NUT (2)
SCREW (4)
LOCKWASHER (4)
SCREW (4)
LOCKWASHER (4)
BLIND RIVET NUT (4)
SCREW (4)
LOCKWASHER (4)
NUT (4)
REAR BELT
SCREW (4)
SELF LOCKING NUT (4)
SCREW (2)
LOCKWASHER (2)
NUT (2)
BRACKET
PIN (2)
COTTER PIN (2)
SCREW
SELF LOCKING NUT
SCREW (6)
SELF LOCKING NUT (6)
SEAT PLATFORM ASSEMBLY
FRAME
SCREW (2)
LOCKWASHER (2)
WASHER (2)
BLIND RIVET NUT (2)
SCREW (4)
BRACKET (2)
NUT (4)
SCREW (2)
PLATE
LOCKWASHER (2)
NUT (2)
SCREW (4)
CLAMP (2)
LOCKWASHER (4)
NUT (4)
TA027687

Figure 2-249. Removal or installation of seat assemblies.

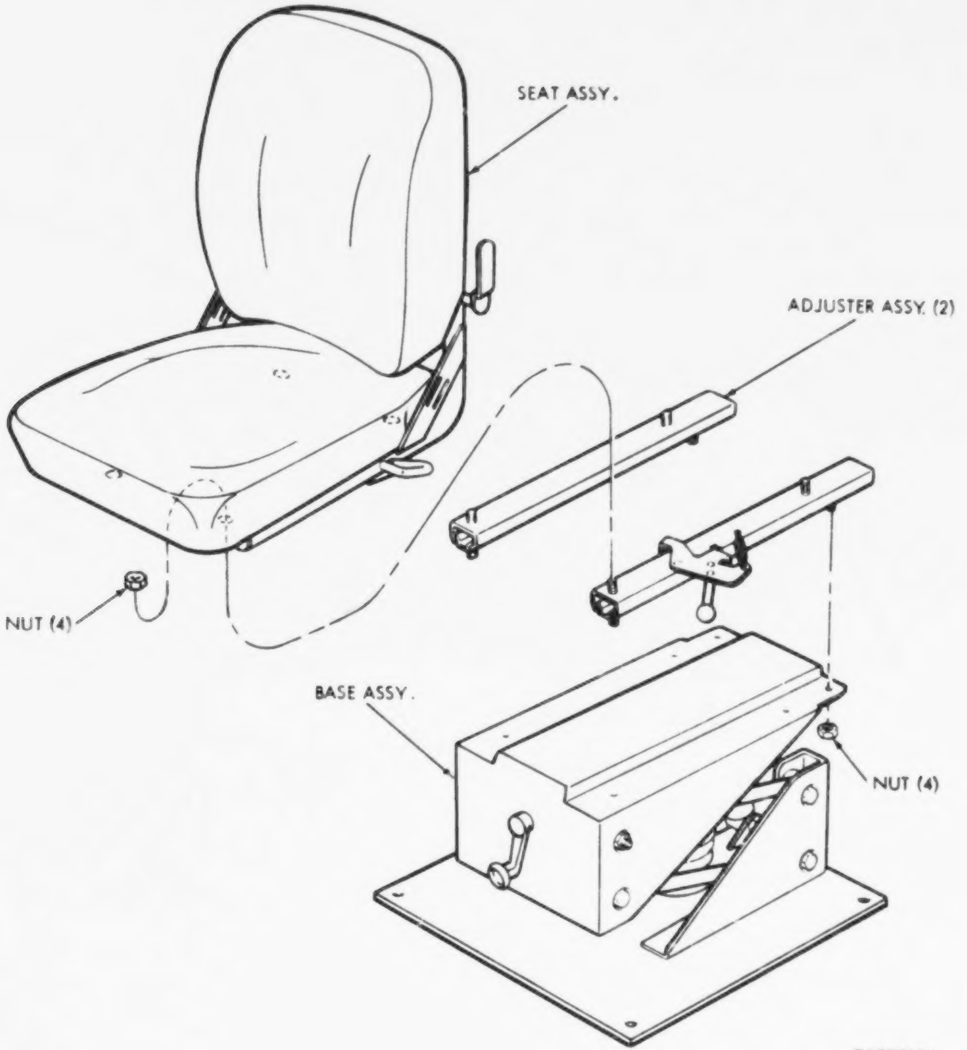


Figure 2-250 Driver's seat — exploded view.

d. Replace or Repair Center Seat.

(1) *Removal.* Unlatch seat at front. Remove two cotter pins and pins securing seat frame at rear. Remove seat. Disassemble battery box cover and cushions from frame (fig. 2-251). Replace parts as required. Assemble battery box cover and cushions to frame.

(2) *Installation.* Position seat and attach two cotter pins and pins to secure seat frame at rear. Latch seat at front.

e. Replace Center Seat Belts (fig. 2-249)

(1) *Removal.* Remove screw, flat washer, and self-locking nut securing each end of seat belt to seat frame.

(2) *Installation.* Install one end of each belt to the seat frame using screw, flat washer, and self-locking nut.

f. Replace Passenger Seat (fig. 2-249)

(1) *Removal.* Remove four screws, lockwashers, and nuts securing seat to frame. If frame is damaged, remove plate and two screws, lockwashers, and nuts secur-

best copy available

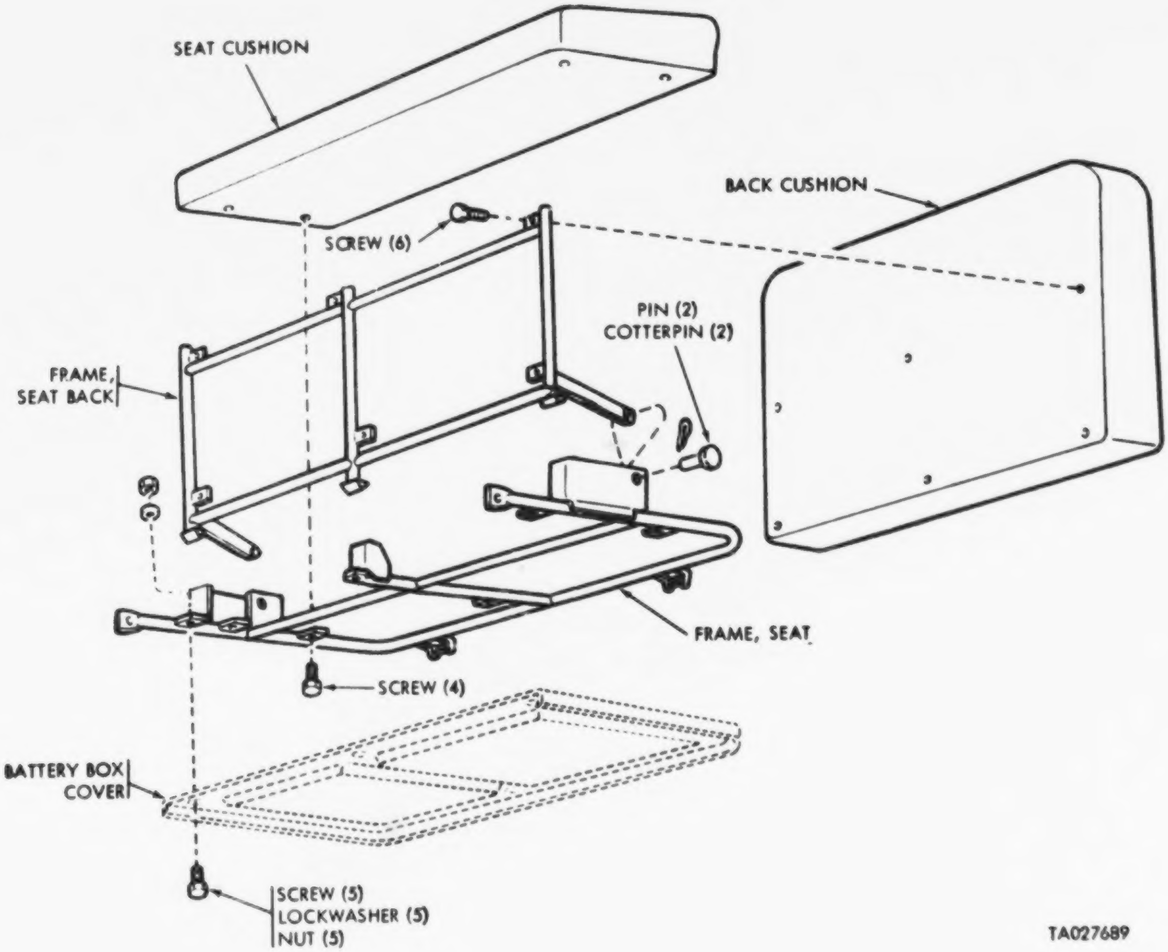

SEAT CUSHION
BACK CUSHION
SCREW (6)
PIN (2)
COTTERPIN (2)
FRAME, SEAT BACK
FRAME, SEAT
SCREW (4)
BATTERY BOX COVER
SCREW (5)
LOCKWASHER (5)
NUT (5)
TA027689

Figure 2-251. Center seat — exploded view.

ing frame to battery box. Remove four screws and self-locking nuts between frame and heater. Remove four screws and lockwashers securing frame to blind rivet nuts in cab rear wall. Remove two cap screws, washers, and lockwashers securing frame to blind rivet nuts in cab floor.

(2) *Installation.* Install two cap screws, washers, and lockwashers to secure frame to blind rivet nuts in cab floor. Install four screws and lockwashers to secure frame to blind rivet nuts in cab rear wall. Install four screws and self-locking nuts between frame and heater. Position frame to battery box and secure by installing two screws, lockwashers, nuts and install plate. Position seat to frame and secure seat by installing four screws, lockwashers, and nuts.

g. Repair Passenger Seat (fig. 2-252).

(1) Disassembly. Remove four machine screws securing frame and seat support plate to seat back cushion.

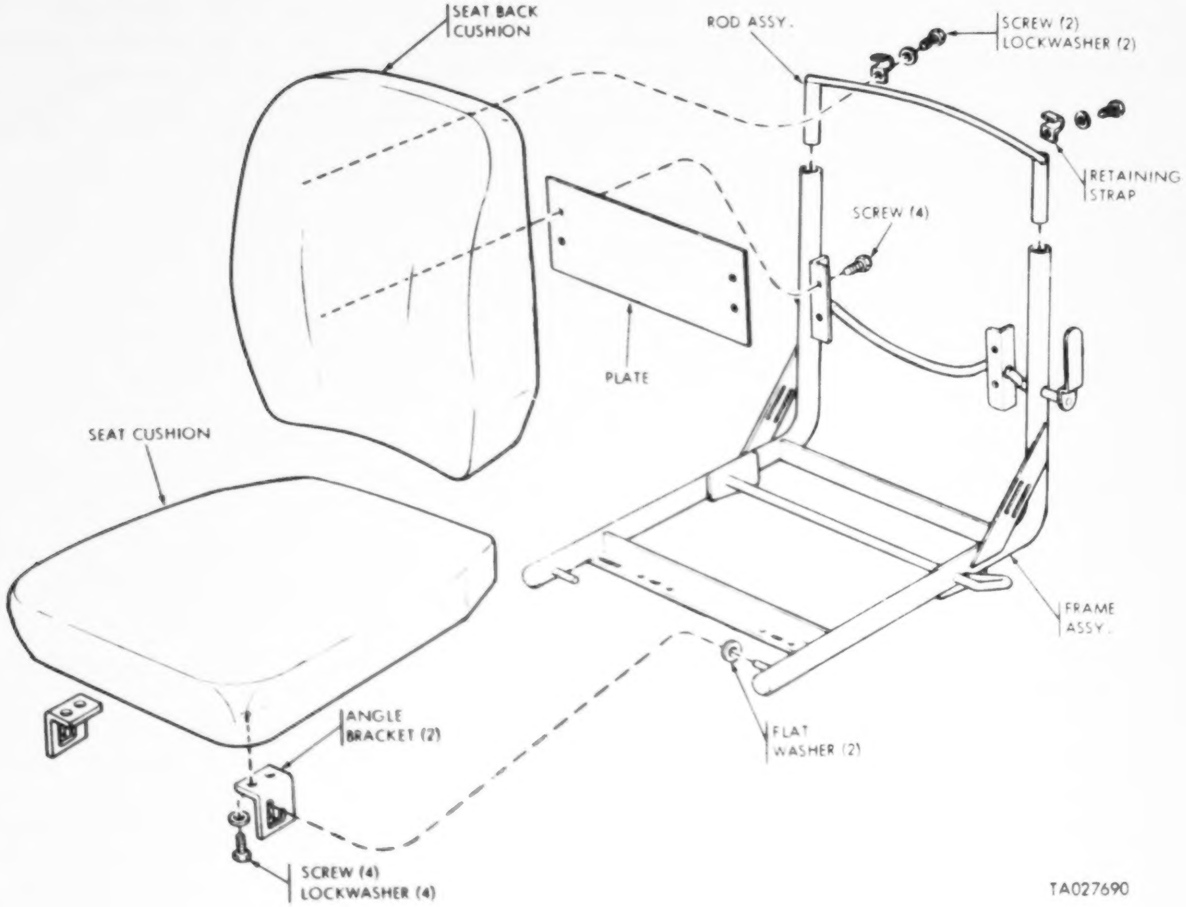

SEAT BACK CUSHION
ROD ASSY.
SCREW (2)
LOCKWASHER (2)
RETAINING STRAP
SCREW (4)
PLATE
SEAT CUSHION
FRAME ASSY.
ANGLE BRACKET (2)
FLAT WASHER (2)
SCREW (4)
LOCKWASHER (4)
TA027690

Figure 2-252. Passenger seat — exploded view.

Remove two machine screws and lockwashers securing retaining straps and back cushion to frame rod assembly. Remove two machine screws and lockwashers securing each angle bracket to seat cushion. Replace parts as required.

(2) *Assembly.* Secure each angle bracket to seat cushion with two machine screws and lockwashers. Secure retaining straps and back cushion to frame rod assembly with two machine screws and lockwashers. Secure frame and seat support plate to seat back cushion with four machine screws.

h. Replace Passenger Seat Belts (fig. 2-249). Remove one screw, flat washer, and self-locking nut securing each end of seat belt to seat frame.

(2) *Installation.* Install one end of each belt to seat frame using one screw, flat washer, and self-locking nut.

2-162. Battery Box

Fig. 2-253

a. Replacement of Seal. Remove old seal. Remove old adhesive with suitable solvent. Cut seal to length required (approximately 107 inches). Bond seal to battery box lip using adhesive type II, spec MIL-A-9052.

b. Replacement of Battery Box Fasteners. Remove and replace fasteners or swage pins as required.

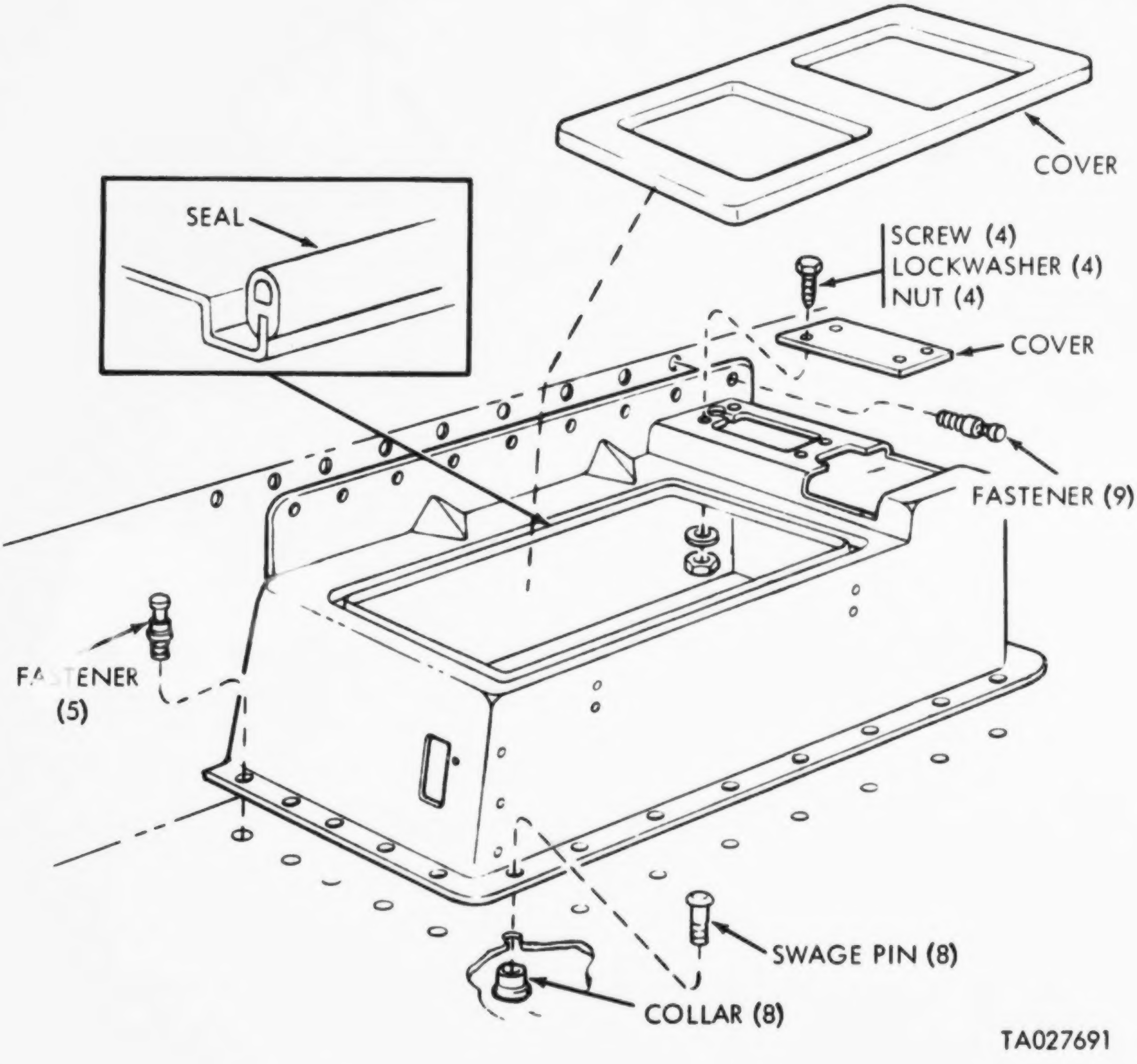

COVER
SEAL
SCREW (4)
LOCKWASHER (4)
NUT (4)
COVER
FASTENER (9)
FASTENER (5)
SWAGE PIN (8)
COLLAR (8)
TA027691

Figure 2-253. Battery box seal.

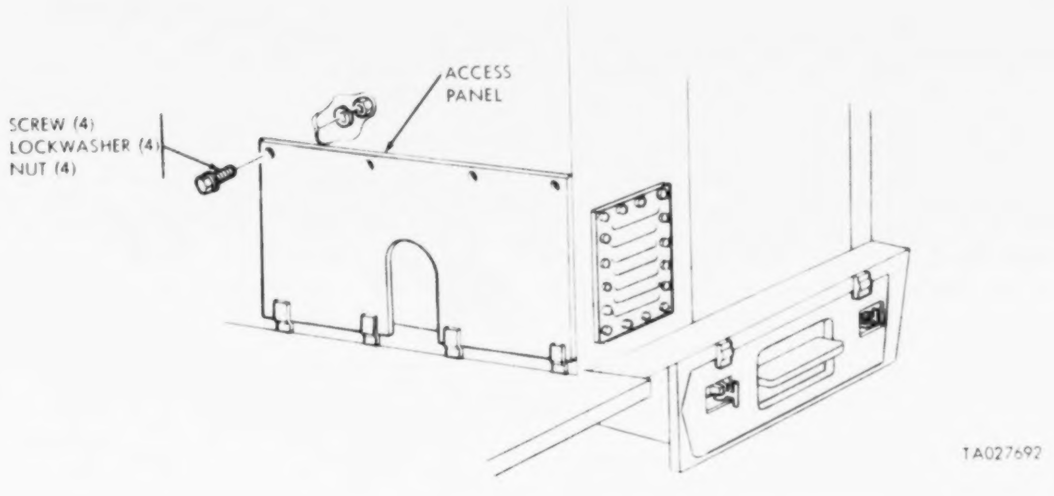


Figure 2-254. Heater compartments panels.

2-163. Personnel Heater Compartment Panels

Fig. 2-254

Removal and Installation of Access Panel. Remove four screws, lockwashers, and nuts securing access panel. Install panel using four screws, lockwashers, and nuts.

2-164. Cab and Body Miscellaneous Components

Figs. 2-255 through 2-260

a. Replacement of Fire Extinguisher Bracket (fig. 2-255). Remove four lockwashers and screws securing fire extiguisher bracket to either pioneer kit stowage box or cab rear wall. Remove bracket. To install bracket, attach four lockwashers and screws securing fire extinguisher bracket to either pioneer kit stowage box or rear cab wall.

b. Replacement of Liquid Container Bracket (fig. 2-255). Remove four nuts, screws, and lockwashers securing liquid container bracket to stowage box. Remove bracket. To install bracket, attach four nuts, screws, and lockwashers securing liquid container bracket to stowage box. Replace strap as required.

c. Replacement of Pioneer Kit Bracket (fig. 2-255). Remove nuts, screws, and lockwashers securing pioneer kit bracket to jackstand board bracket. Remove bracket. To install bracket, attach nuts, screws, and lockwashers, securing pioneer kit bracket to jackstand board bracket. Replace straps as required.

d. Replacement of Jackstand Board Bracket (fig. 2-255). Remove six screws, lockwashers, and nuts securing pioneer kit bracket to jackstand board bracket. Remove pioneer kit bracket. Remove eight screws and lockwashers securing jackstand board bracket to stowage box. Remove bracket. To install bracket, attach eight screws and lockwashers, securing jackstand board bracket to stowage box. Position pioneer kit bracket and attach to jackstand board bracket with six screws, lockwashers, and nuts securing pioneer kit bracket to jackstand board bracket. Reinstall pioneer kit bracket.

e. Replacement of First Aid Kit Bracket (fig. 2-256). Remove four screws, washers, lockwashers, and nuts securing first aid kit bracket to strip plates on cab frame. Remove bracket. To install bracket, attach four screws, washers, lockwashers, and nuts securing first aid kit bracket to strip plates on cab frame. Replace strap as required.

f. Replacement of Decontamination Kit Bracket (fig. 2-256). Remove three screws, lockwashers, and nuts securing decontamination kit bracket to cab wall. Remove bracket. To install bracket, attach three screws, lockwashers, and nuts securing decontamination kit bracket to cab wall.

g. Replacement of Spare Tire Carrier (fig. 2-257). The spare tire carrier is mounted on the right side of the vehicle, just forward of and below the winch.

(1) *Removal.* If spare tire is in carrier, remove according to paragraph 2-129. Otherwise, remove two upper carrier retaining pins and washers. Allow outside edge of carrier to swing down until edge rests on ground.

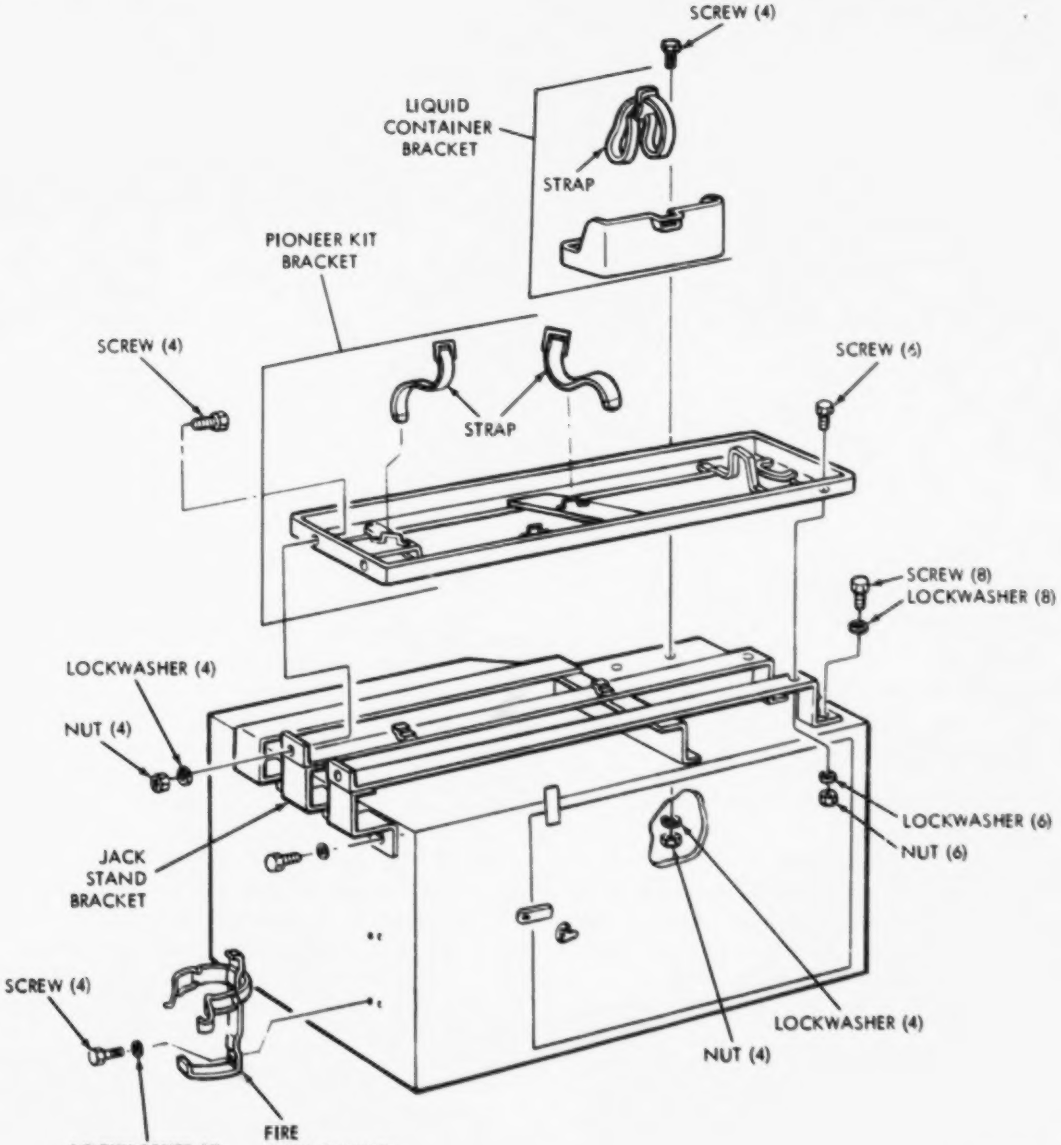

SCREW (4)
LIQUID CONTAINER BRACKET
STRAP
PIONEER KIT BRACKET
SCREW (4)
STRAP
SCREW (6)
SCREW (8)
LOCKWASHER (8)
LOCKWASHER (4)
NUT (4)
JACK STAND BRACKET
LOCKWASHER (6)
NUT (6)
SCREW (4)
LOCKWASHER (4)
NUT (4)
LOCKWASHER (4)
FIRE EXTINGUISHER BRACKET
TA027693

Figure 2-255. Liquid container, fire extinguisher, pioneer kit and jackstand board brackets.

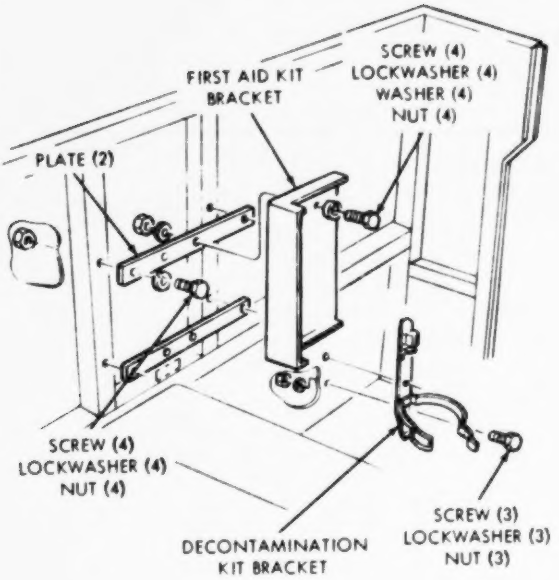

FIRST AID KIT
BRACKET
SCREW (4)
LOCKWASHER (4)
WASHER (4)
NUT (4)
PLATE (2)
SCREW (4)
LOCKWASHER (4)
NUT (4)
DECONTAMINATION
KIT BRACKET
SCREW (3)
LOCKWASHER (3)
NUT (3)
TA027694

Figure 2-256. First aid kit and decontamination kit brackets.

Place suitable support beneath lower inside edge. Remove two lower cotter pins, pins, and washers. Remove support and allow inside edge of carrier to lower to ground. Replace parts as required.

(2) *Installation.* Position carrier and support and attach two lower cotter pins, pins and washers. With support beneath lower inside edge of carrier, install two upper carrier retaining pins and washers. Install spare tire carrier if previously removed.

h. Replace Rifle Racks (figs. 2-258 and 2-259). Remove any of three rifle butt brackets by removing two screws, lockwashers and nuts securing each bracket in cab. Remove bracket(s).Remove either of three catches by removing two screws, lockwashers and nuts securing catch to catch bracket and catch bracket to wall. Remove catch(es) and catch bracket(s). Extreme right rifle catch bracket is mounted against a spacer plate. Other right catch bracket is mounted on another bracket. Replace any of these parts as required. Maintain legible decals for rifle stowage location on cab walls.

i. Replace Data and Instruction Plates (fig. 2-260). Refer to figure 2-260 and replace data and instruction plates as required.

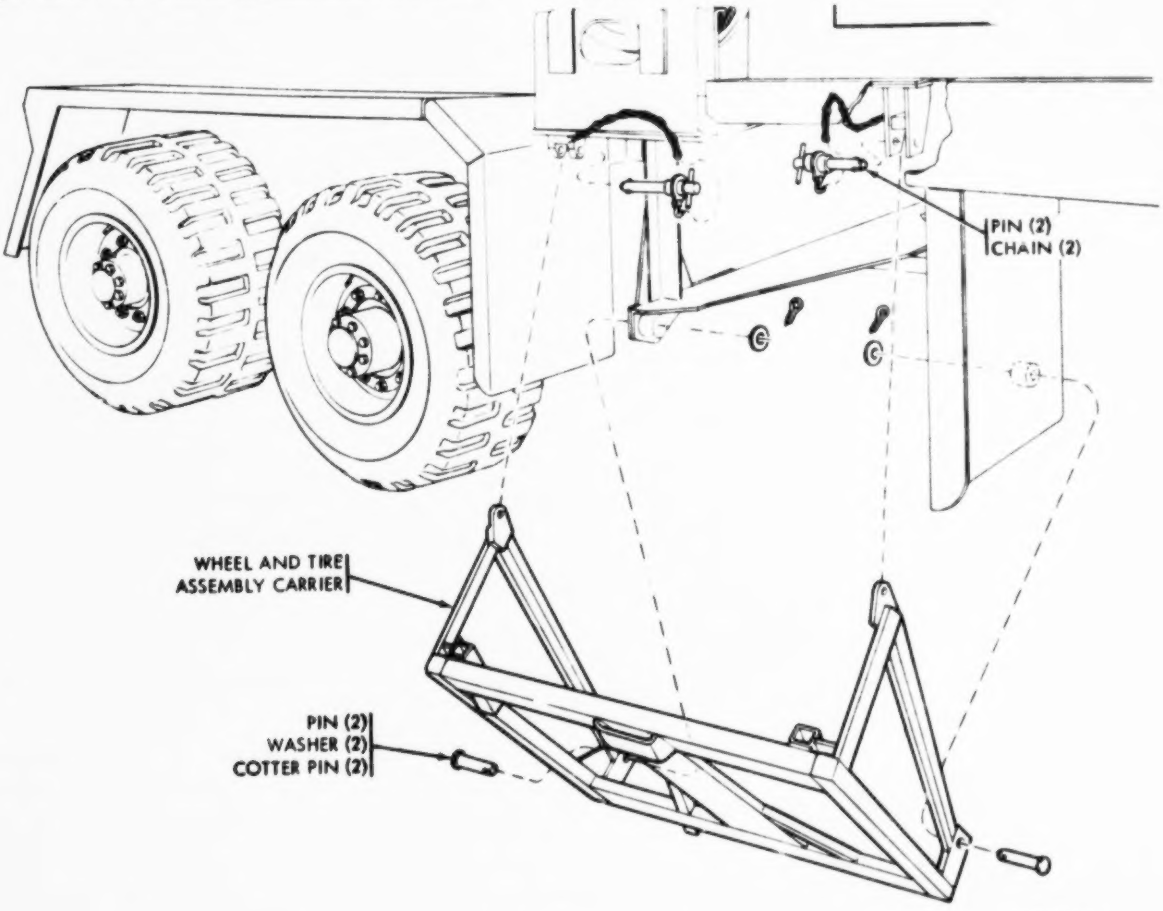

PIN (2)
CHAIN (2)
WHEEL AND TIRE
ASSEMBLY CARRIER
PIN (2)
WASHER (2)
COTTER PIN (2)
TA027695

Figure 2-257. Spare tire carrier.

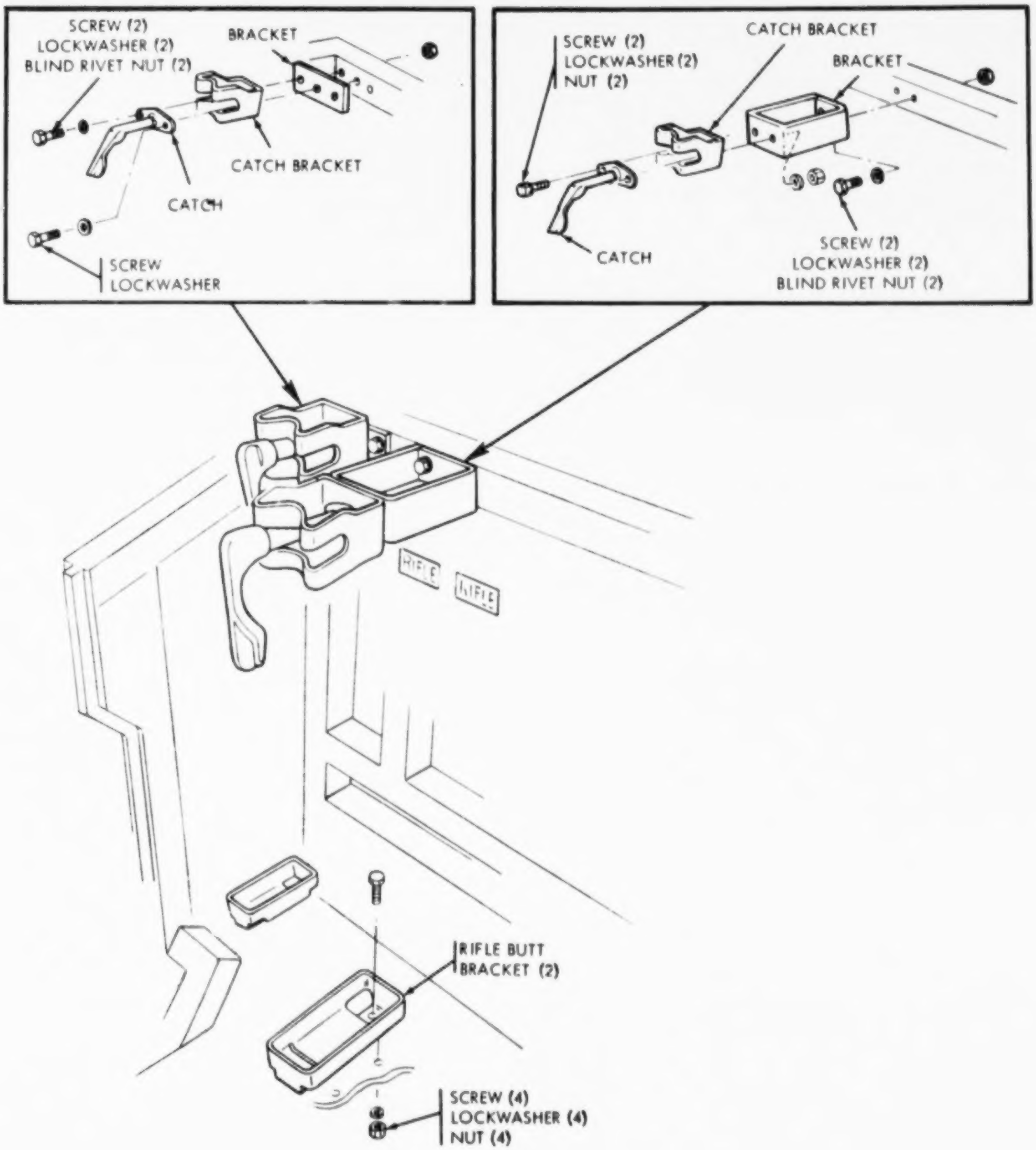

SCREW (2)
LOCKWASHER (2)
BLIND RIVET NUT (2)
BRACKET
CATCH BRACKET
CATCH
SCREW
LOCKWASHER
SCREW (2)
LOCKWASHER (2)
NUT (2)
CATCH BRACKET
BRACKET
CATCH
SCREW (2)
LOCKWASHER (2)
BLIND RIVET NUT (2)
RIFLE
RIFLE
RIFLE BUTT
BRACKET (2)
SCREW (4)
LOCKWASHER (4)
NUT (4)
TA027696

Figure 2-258. Right side rifle racks — exploded view.

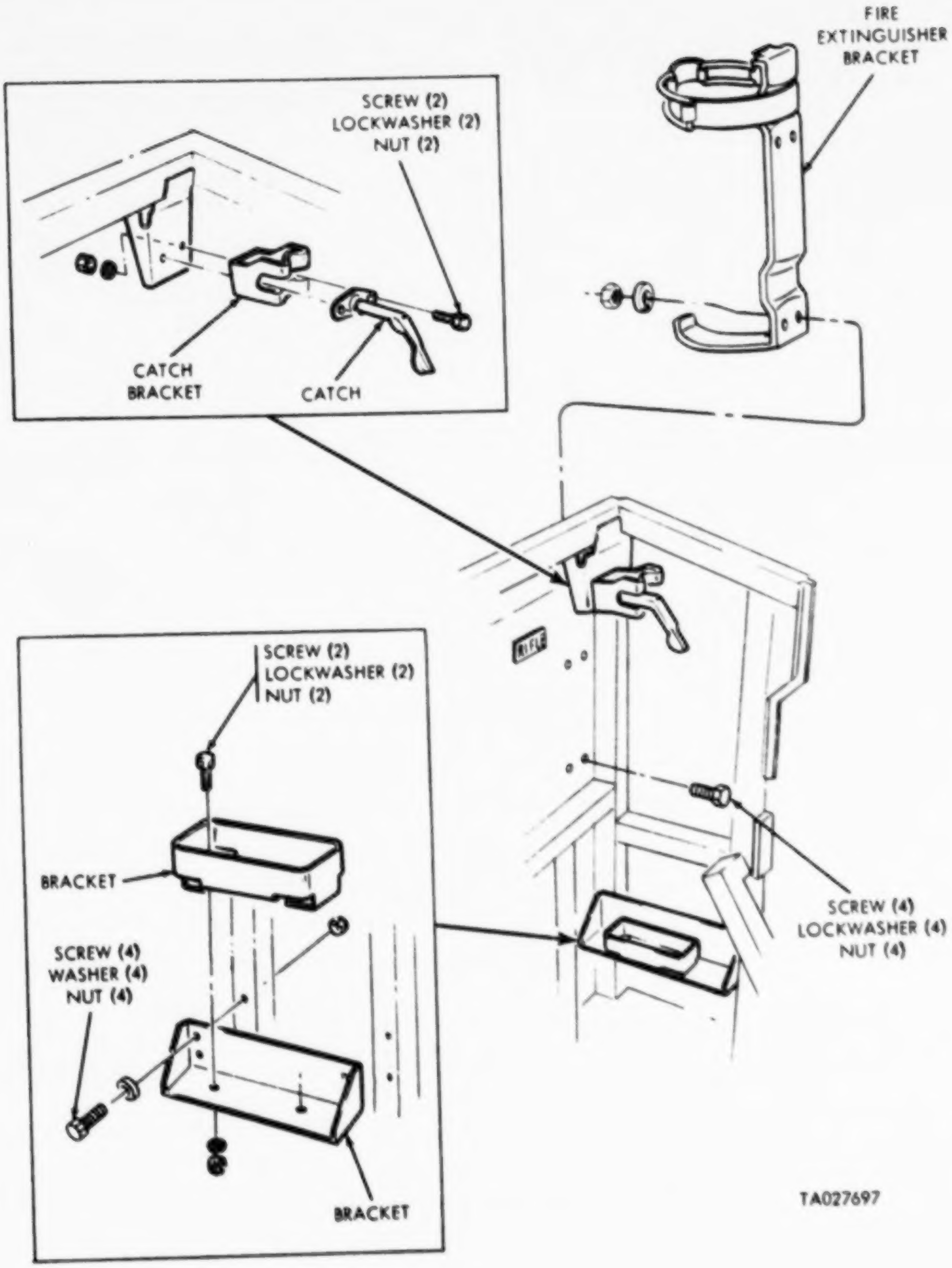

FIRE EXTINGUISHER BRACKET
SCREW (2)
LOCKWASHER (2)
NUT (2)
CATCH BRACKET
CATCH
RIFLE
SCREW (2)
LOCKWASHER (2)
NUT (2)
BRACKET
SCREW (4)
WASHER (4)
NUT (4)
BRACKET
SCREW (4)
LOCKWASHER (4)
NUT (4)
TA027697

Figure 2-259. Left side rifle racks and external fire extinguisher mounting bracket.

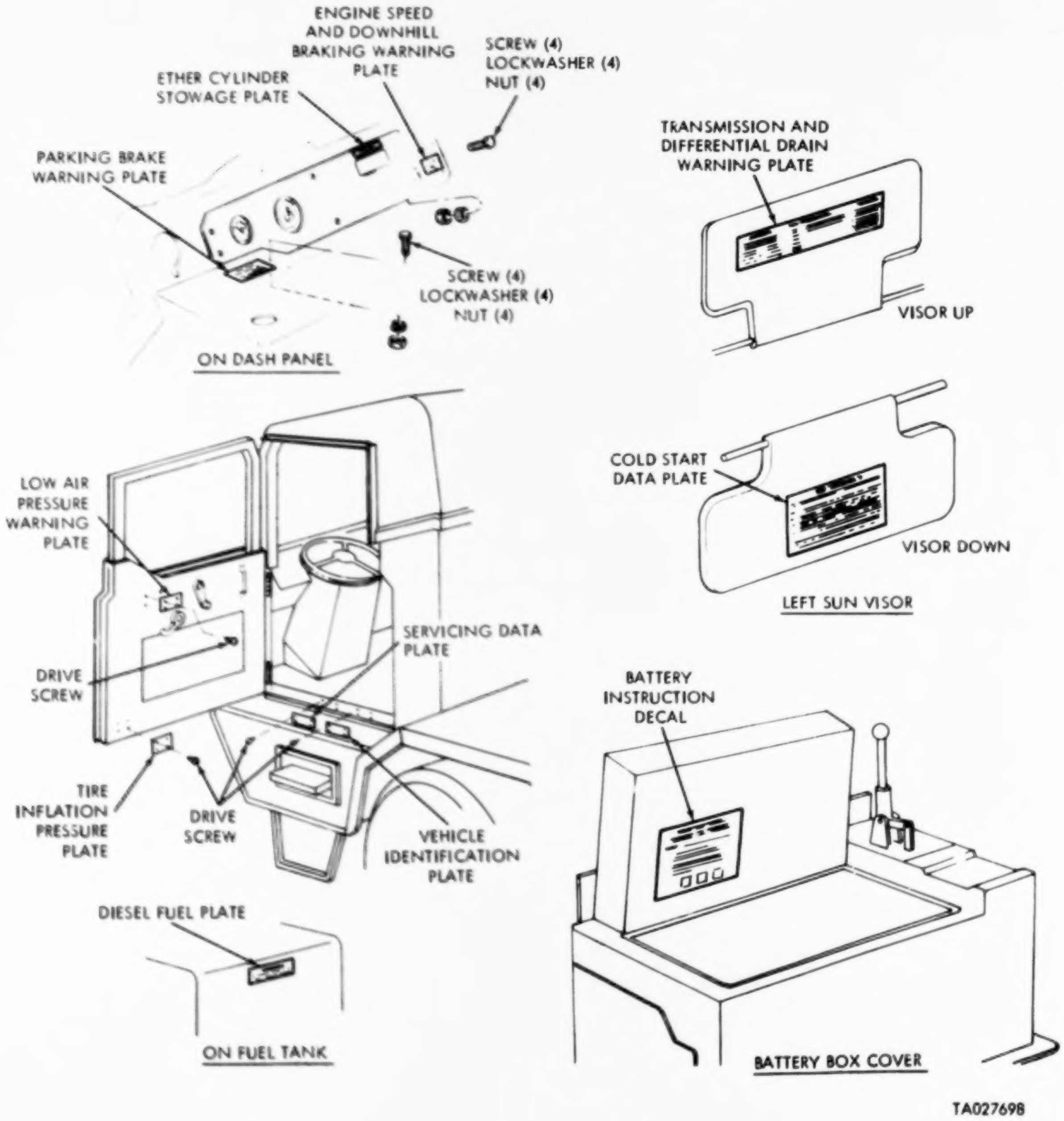

ENGINE SPEED AND DOWNHILL BRAKING WARNING PLATE
SCREW (4)
LOCKWASHER (4)
NUT (4)
ETHER CYLINDER STOWAGE PLATE
PARKING BRAKE WARNING PLATE
SCREW (4)
LOCKWASHER (4)
NUT (4)
ON DASH PANEL
TRANSMISSION AND DIFFERENTIAL DRAIN WARNING PLATE
VISOR UP
COLD START DATA PLATE
VISOR DOWN
LEFT SUN VISOR
LOW AIR PRESSURE WARNING PLATE
DRIVE SCREW
SERVICING DATA PLATE
TIRE INFLATION PRESSURE PLATE
DRIVE SCREW
VEHICLE IDENTIFICATION PLATE
DIESEL FUEL PLATE
ON FUEL TANK
BATTERY INSTRUCTION DECAL
BATTERY BOX COVER
TA027698

Figure 2-260. Vehicle data and instruction plates.

j. Reflector Tape. When replacing the M746 night driving reflectors, (red and amber adhesive tape) use the following method:

(1) Remove damaged reflector and scrape and clean the vehicle surface.

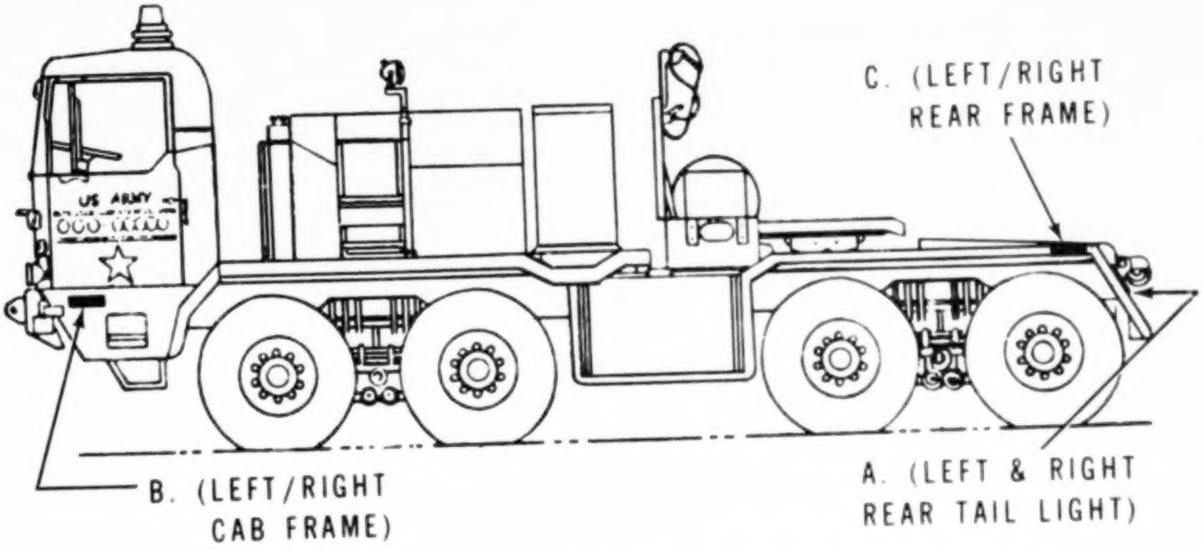
(2) Remove the protective backing from the required adhesive tape reflector.

(3) Apply the reflector tape to the vehicle in the applicable location shown in figure 2-260.1.

(4) Roll reflector tape firmly to eliminate air bubbles and ensure proper bond to the surface.

(5) Apply sealer to edge of reflector surface.

(6) Paint edges of reflector surface area as required.


C. (LEFT/RIGHT REAR FRAME)
US ARMY
B. (LEFT/RIGHT CAB FRAME)
A. (LEFT & RIGHT REAR TAIL LIGHT)

LOC	COLOR	NSN	SIZE	
			L	W
A	RED	9905-00-182-5041	4.50	4.50
B	AMBER	9905-00-935-7773	4.50	4.50
C	RED	9905-00-178-5854	2.75	10.50

SEALER	8010-00-027-8378

TA055045

Figure 2-260.1. Reflector Tape.

Section XXVI. WINCHES AND WINCH COMPONENTS

2-165. Winch Hydraulic System

a. Description (fig. 2-261). The M746 tractor is equipped with two similar winches mounted on the frame behind the power plant compartment. Each winch is driven by a hydraulic motor mounted on the inboard side of the winch and is braked internally by spring tension applied against clutch plates. The brakes are released by hydraulic pressure whenever the motor is operating. Pressurized oil is delivered through a feed line and acts against the brake release piston. The piston rod is attached to the first stage carrier assembly on which one set of clutch plates is mounted. Hydraulic pressure (200 psi min.) on the piston pulls the carrier clutch plates away from the set of clutch plates mounted internally on the drum, and the winch becomes free to rotate. Pressurized hydraulic fluid is supplied to each winch separately by a positive displacement, rotary vane type, double pump, mounted to and driven by the transmission power takeoff. Pump output is limited to 1450 plus or minus 100 psi by the two relief valves mounted in the dual purpose reservoir. An anticavitation valve between each winch motor and the appropriate pump discharge port operates as a safeguard against pump cavitation when the winches are reeled in. A pilot line from the pressure line routes hydraulic flow against a spool in the anticavitation valve and opens the return line passage to unrestricted flow. However, if the payload suddenly breaks free of the winching cables, or rolls forward on its own on the trailer, the valve acts to prevent the motor from overrunning pump delivery (cavitation). A pressure drop immediately occurs in the pilot line, forcing the spool to move against the weaker pressure of the fluid in the return line, thus restricting the return passage and creating back pressure in the return line. This back pressure slows down the motor until pump delivery catches up with it. When the winches are reeled out, a check valve in the anticavitation valve return passage opens and allows unrestricted flow back to the reservoir as long as the motor is running. Each winch motor is of the rotary vane, positive displacement type. Each winch is controlled separately by a manual control valve handle from a station located at the forward side of the reservoir on the left side of the vehicle. Each control valve handle has 3 positions: forward, center, and rearward. With the handle in the center position, pump discharge is merely returned to the reservoir, a low pressure condition is created in the pressure lines to the winch brake controls, and the winch brakes automatically apply. When the handle is moved from the center position, high pressure returns to the brake control pressure lines and the winch brakes release. With the handle in the rearward position (away from the operator) pressurized fluid is routed to the upper inlet of the motor and the winch is turned rearward (reeled out). With the handle in the forward position (toward the operator) pressurized fluid is routed to the motor lower inlet and the winch is turned forward (reeled in). In each case, during winching, the cable winds from the top of the winch spool. When either the upper or lower port of the motor becomes the pressure inlet, the other port becomes the outlet and becomes the return port to the reservoir. Each winch motor is also provided with a drain line to the reservoir to drain oil retained in the motor through internal slippage and leakage. At the control station, an on-off switch is provided that controls the winch power takeoff. The switch opens a solenoid valve, normally closed, that permits pressurized transmission oil to enter the power takeoff and cause the power takeoff drive gears to engage. Similarly, because pump discharge pressure and flow are proportional to engine speed, a hand throttle control for the engine is provided to allow the winch operator to bring the hydraulic system pressure up to operating requirements of 1450 to 1550 psi at 550 to 2200 engine rpm. The reservoir has a 40 gal. capacity and is used for the power steering, as well as the winch, hydraulic system. The reservoir contains a submersible filter assembly with a filter cartridge that can be removed for cleaning or replacement without draining the oil from the operator. The filter assembly cover is exposed to view on the outside wall of the reservoir and has a dial indicator that shows automatically whether the filter is clean, needs cleaning, or is so dirty that the oil is bypassing the filter altogether. The filter assembly contains a magnet for removing metallic particles from the oil, and a 75 micron pleated element for removing non-metallic particles. Hydraulic fluid is drained by gravity from a drain line beneath and to the left of the reservoir. The drain line is stopped at the end by a removeable plug as well as being provided with a manual control drain valve. The reservoir is filled from the top through an access hole that normally holds the reservoir air filter. The air filter has a nominal rating of 30 microns and the oil fill filter has a 100-mesh screen to remove particles during oil filling. The winch system 1450 psi relief valves are mounted internally in the reservoir and are reached for maintenance through the air filter mounting plate access hole.

b. Tabulated Data. Refer to paragraph 1-7.

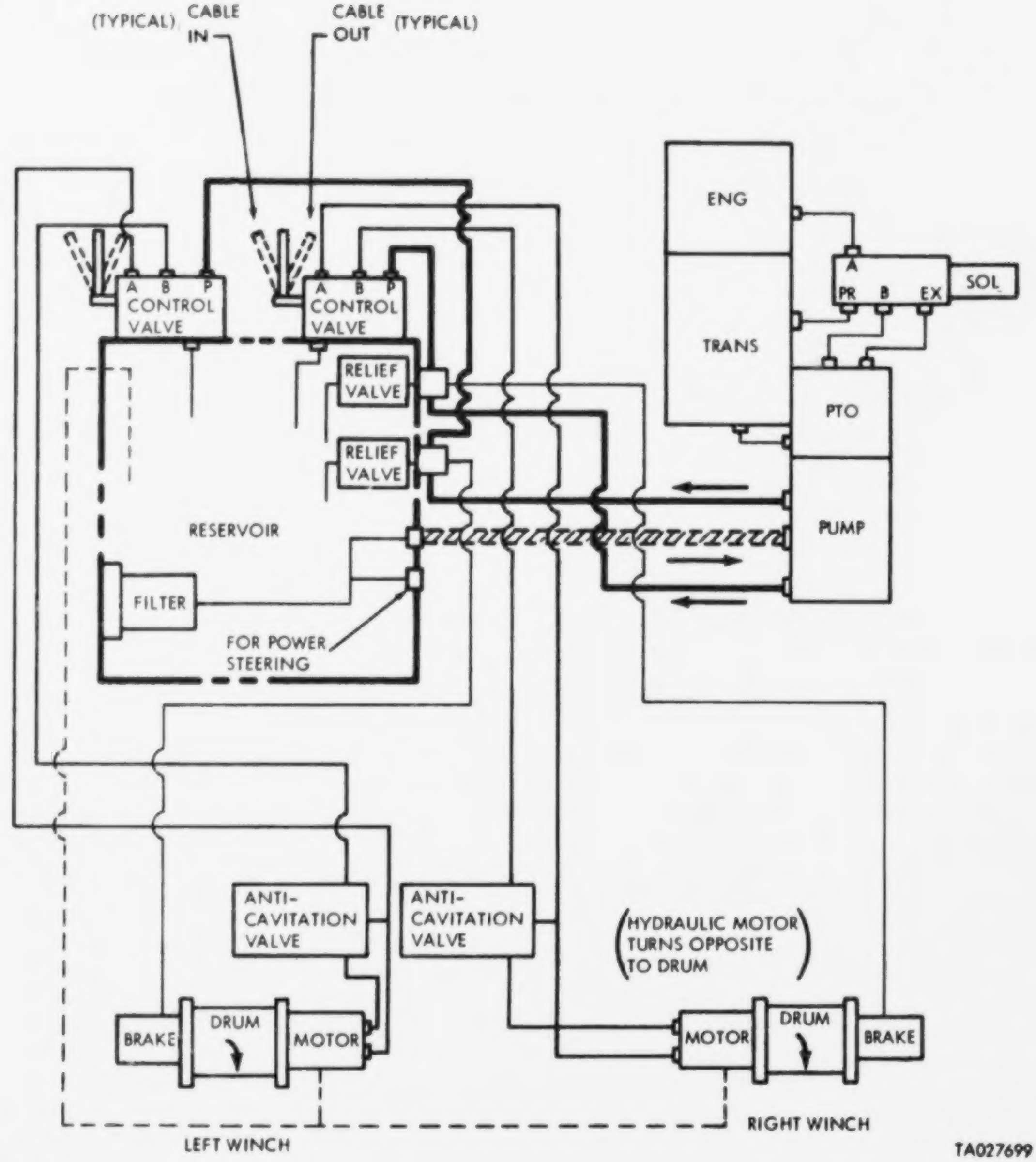

(TYPICAL)
CABLE IN
CABLE OUT
(TYPICAL)
ENG
A
PR
B
EX
SOL
A
B
P
CONTROL VALVE
A
B
P
CONTROL VALVE
TRANS
RELIEF VALVE
PTO
RELIEF VALVE
RESERVOIR
PUMP
FILTER
FOR POWER STEERING
ANTI-CAVITATION VALVE
ANTI-CAVITATION VALVE
(HYDRAULIC MOTOR TURNS OPPOSITE TO DRUM)
BRAKE
DRUM
MOTOR
MOTOR
DRUM
BRAKE
RIGHT WINCH
LEFT WINCH
TA027699

Figure 2-261. Winch hydraulic system schematic.

2-166. Winch Brake Adjustment

Fig. 2-262

NOTE

Repeat after replacement of internal winch parts.

a. Adjustment of Winch Brakes. Remove cap and gasket from brake control rod and loosen jamnut and brake adjusting nut to end of threads. Assure that winch cable end is detached from frame cable retaining bracket. With engine running, turn on PTO switch and move appropriate winch control handle from center to either operating position. This action assures that the brake piston is held at the top of its stroke. The winch clutch plates are now engaged. Maintain hydraulic pressure and thread adjusting nut until nut touches end of piston stem. Tighten adjusting nut 1-1½ turns further. Relieve hydraulic pressure. Tighten jamnut and install gasket and cap.

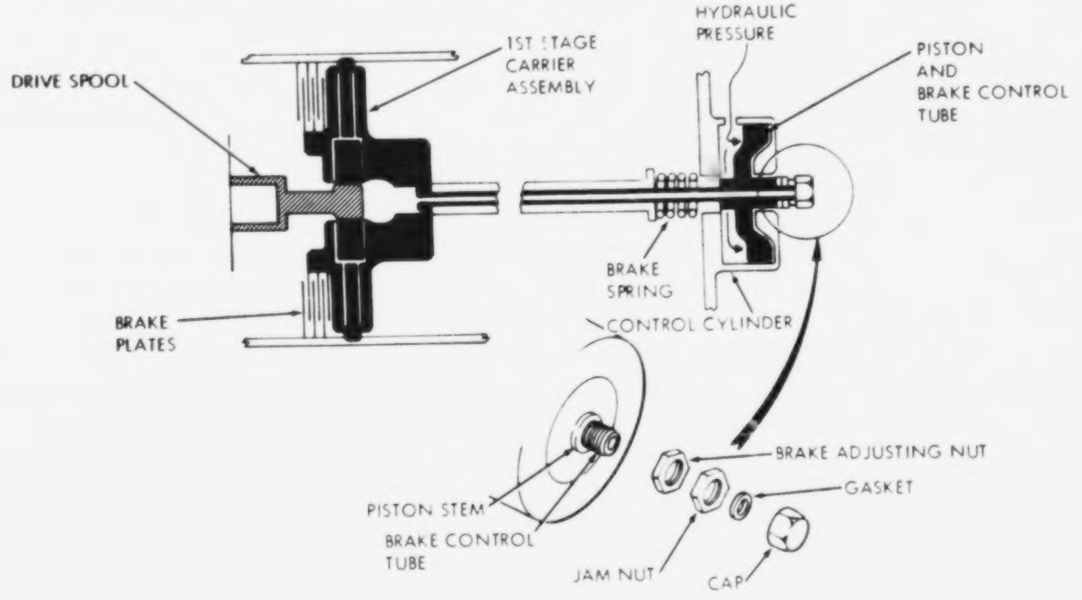


Figure 2-262. Winch brake adjustment.

TA027700

2-167. Winch Cable Replacement

a. Removal. Fully pay out cable from winch and wind discarded cable on suitable receiving drum.

b. Installation. Insert dead-end ferrule of serviceable cable into groove on drum. Be sure ferrule is securely lodged in groove. Tap ferrule with sledge hammer as necessary to ensure snug fit. Haul in cable carefully, making sure cable lays up properly on drum.

2-168. Hydraulic Filter

Fig. 2-263

a. Removal.

NOTE

Draining of reservoir is not necessary for removal of filter since an automatic cutoff valve in the filter housing prevents loss of fluid. However, provide a suitable container and splash plate to drain excess fluid (approximately one gallon).

(1) Remove four nuts and lockwashers that secure filter cover to reservoir (fig. 2-263).

(2) Carefully pull cover straight out from reservoir. Filter cartridge comes out with cover. Observe that valve piston (inner wall of housing assembly in reservoir) has shut tight against housing seat. If valve piston binds and oil continues to drain, jar valve piston forward by hand.

(3) Pull filter cartridge from cover allowing dial indicator and helix to rotate freely in cartridge slot.

b. Cleaning, Inspection and Repair.

(1) Wash cartridge in trichlorethylene or other suitable cleaning solvent. Blow dry from inside or thoroughly shake off excess.

CAUTION

Do not rub element with brush or wipe with rag; damage to fine mesh element may result. Always handle element with care when removing, cleaning, or replacing.

(2) Inspect cartridge for tears, punctures, or shredded condition. Replace cartridge if damaged or badly soiled even after cleaning.

(3) Wipe metallic particles off magnet on cover assembly.

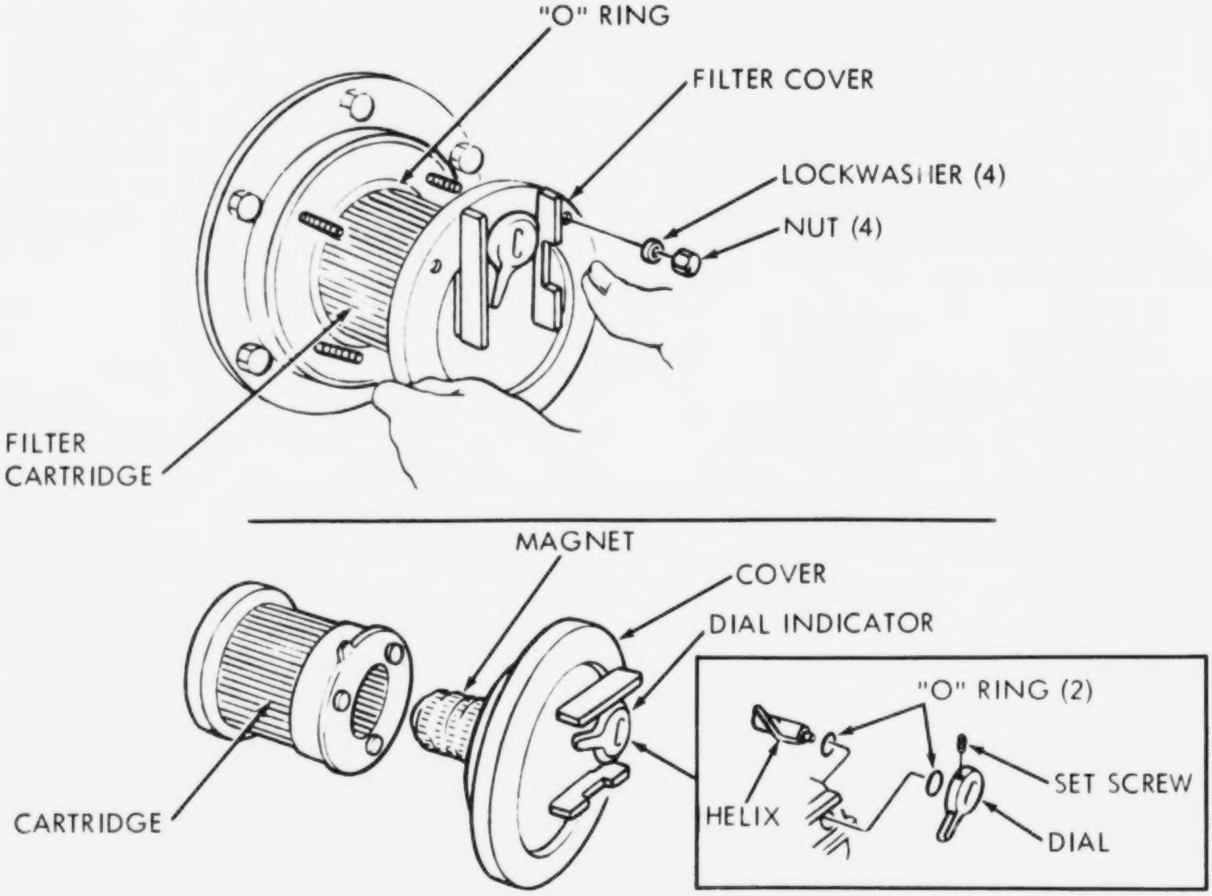


Figure 2-263. Removal and disassembly of hydraulic filter.

(4) Replace indicator dial or helix, if damaged. Use socket head key GGG-K-275 to remove or install dial setscrew.

(5) Inspect cover to housing O ring for damage and replace if necessary.

c. Installation.

(1) Set dial indicator to FILTER IS CLEAN.

(2) Install cartridge on cover assembly. Aline helix on cover with cartridge slot and push cartridge and cover together allowing helix and dial indicator to rotate freely.

(3) Insert cover with cartridge into filter housing in reservoir. Secure using four nuts and lockwashers.

(4) Move reservoir supply shutoff valve handle to closed position. Lock in place with lockwire.

d. Replacement of Filter Assembly.

(1) Drain reservoir (approximately 40 gal.).

(2) Remove eight screws and lockwashers (fig. 2-271) securing filter assembly to reservoir. Turn filter assembly counterclockwise until assembly is free from threaded tube inside reservoir. Remove filter assembly, gasket, and O ring.

(3) Use new O ring and gasket when installing filter assembly. To install filter assembly, attach gasket, and O ring. Turn filter assembly clockwise until assembly is seated with threaded tube inside reservoir. Attach eight screws and lockwashers to secure filter to reservoir.

2-169. Draining and Filling Reservoir

CAUTION

Engine must be off during draining of reservoir.

a. Draining (fig. 2-264).

(1) Provide suitable drain pan below drain spout (approximately 40 gallons).

(2) Remove lockwire from drain valve and plug at spout. Remove plug and open drain valve.

(3) Close drain valve after draining. Install plug at end of drain spout and install lockwire.

(4) If necessary, remove and clean hydraulic filter element.

(5) Inspect air filter screen. If necessary, remove and clean.

b. Filling and Bleeding After System has been Completely Drained.

(1) Remove fill cap (fig. 2-265).

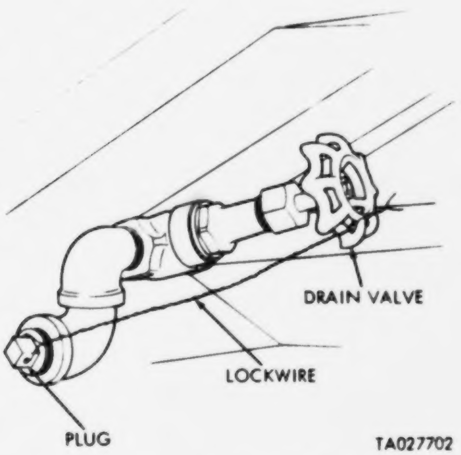


Figure 2-264. Reservoir drain

(2) Fill reservoir with OE-10, MIL-L-2104 until fluid appears at top of sight gage.

(3) Start engine but be ready to add oil as soon as engine is started and is running at idle.

(4) Maintain a full reservoir by adding oil as necessary for a minute or so without turning steering wheel. This allows the larger air bubbles in the lines to excape.

(5) Slowly turn steering wheel avoiding any abrupt changes of speed or pressure (engine runs at idle). Add oil as necessary to maintain full reservoir. Four or five turns of wheel are generally enough to eliminate most of the air from the cylinders.

NOTE

At this point, some systems will have eliminated practically all the air from the system, while others will retain a great deal of air in the oil, generally in the form of very small bubbles as evidenced by cloudy or creamy appearance to the oil. If the oil is clear and the steering is normal, adjust oil level in reservoir to recommended level and secure the system. If there is any doubt or if the oil shows air to be present, proceed as follows:

(6) Allow engine to run at 1000 to 1500 rpm for a few minutes, turning the steering wheel from stop to stop about once every minute. The pause between turning the wheel allows air to form larger bubbles in the cylinders which are easier to expell from the oil when they reach the reservoir. Continue this procedure until oil is clear. Add fluid as required to maintain full reservoir, and install fill cap.

2-170. Reservoir Air Filter

Fig. 2-265

a. Inspection. Remove filter cap and inspect filter screen for clogging. Run finger along screen surface and check for amount of residue. If dirt on screen blocks or impedes normal flow of air, remove screen and clean.

b. Removal. Remove six slotted screws securing mounting flange to reservoir mounting plate. Remove cap, mounting flange, and screen.

c. Cleaning. Clean filter screen in suitable solvent and blow dry with air hose.

d. Installation. Install screen, mounting flange, and cap with six slotted screws which secures mounting flange to reservoir mounting plate.

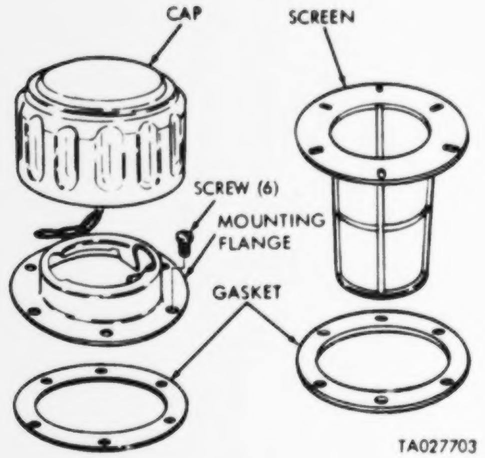


Figure 2-265. Removal and installation of reservoir air filter assembly.

2-171. Winch Transmission Oil

Fig. 2-266

a. Checking Oil Level. Rotate drum until ⅛-inch pipe plugs on either end face of drum are horizontally across from center of winch. Remove inspection plug at motor end and see if oil appers (A, fig. 2-266). Fill to level of inspection hole if oil does not appear.

b. Draining. Rotate drum until ⅛-inch pipe plugs are at bottom. Provide suitable splash plate and container below drain holes. Remove outboard ⅛-inch pipe plug and both ¼-inch pipe plugs at cylinder end (B, fig. 2-266). Due to tight gear pack, draining is slow. After draining, clean and reinstall plugs.

c. Filling. Remove ¼-inch pipe fill plug (A, fig. 2-266) at control cylinder end and add OE oil until oil appears at inspection hole at motor end (five to six quarts). Install fill and inspection plugs after filling.

d. Checking Vent Operation. Pull small piston on vent (B, fig. 2-266) outward. Piston should move easily and freely. If piston sticks and cannot be freed by working in and out, replace vent.

2-172. Winch Hydraulic System Lines and Fittings

Figs. 2-267 and 2-268

a. Replacement of Lines or Fittings. Refer to figures 2-267 and 2-268. If tubing is found with dents, kinks, cracks or holes, replace tubing. If connections leak de-

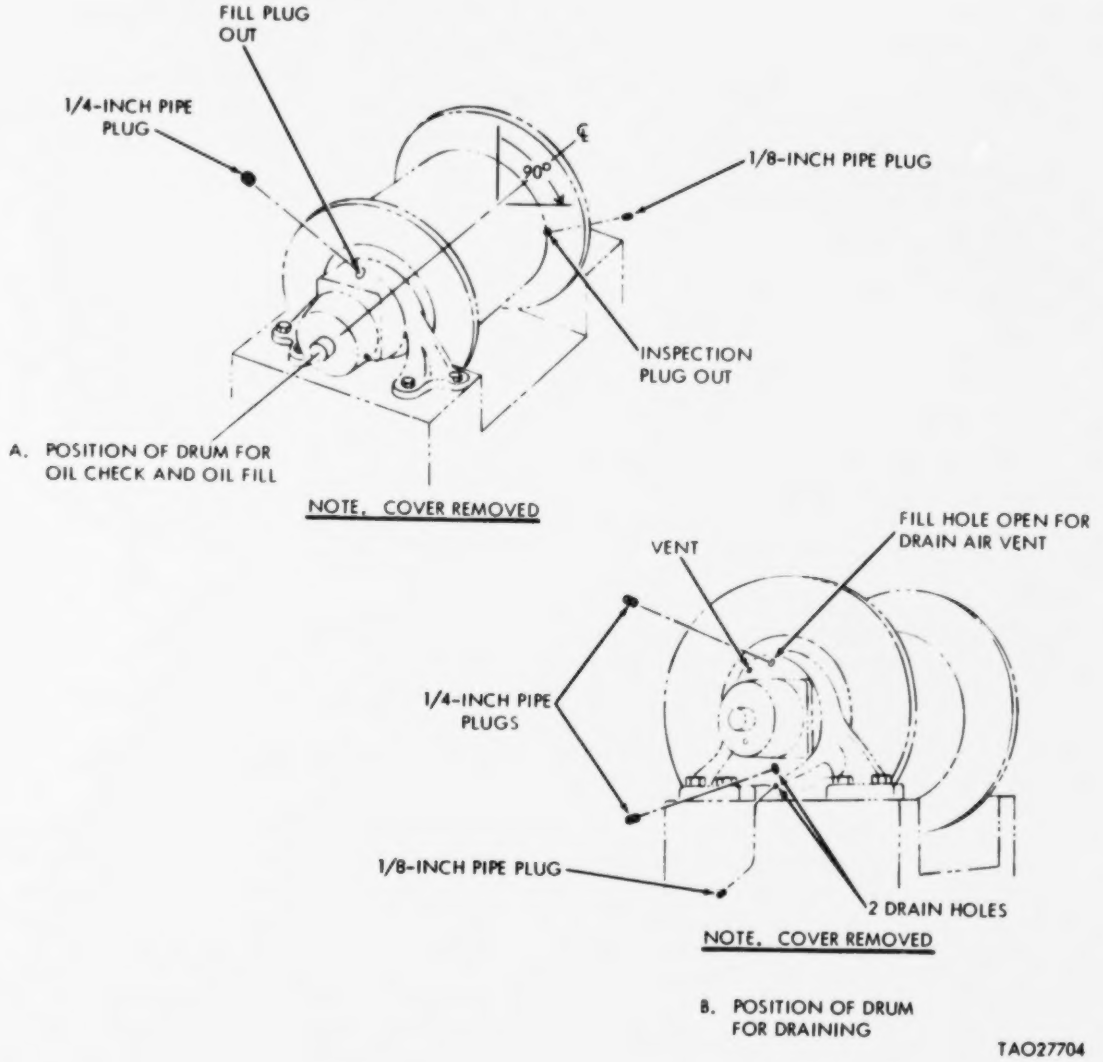

FILL PLUG OUT
1/4-INCH PIPE PLUG
90°
℄
1/8-INCH PIPE PLUG
INSPECTION PLUG OUT
A. POSITION OF DRUM FOR OIL CHECK AND OIL FILL
NOTE. COVER REMOVED
VENT
FILL HOLE OPEN FOR DRAIN AIR VENT
1/4-INCH PIPE PLUGS
1/8-INCH PIPE PLUG
2 DRAIN HOLES
NOTE. COVER REMOVED
B. POSITION OF DRUM FOR DRAINING
TA027704

Figure 2-266. Winch drain and fill points.

spite previous tightening, disassemble connection and replace packing and/or fitting. Make sure tubing, fittings, and packing are clean during installation.

CAUTION

Do not use pliers on connections. Use only suitable wrench.

Clamp or strap tubing in place. Secure clamps or straps with screws and lockwashers.

b. Checking Winch Hydraulic Pressure. Remove cap from front tee (view J, fig. 2-267) and install swivel nut of special tool tube on tee. Install gage 10946819 in other end of tube. Start engine and adjust speed for winching. Actuate winch control lever to CABLE OUT position and observe gage. Gage should indicate 1350 to 1550 psi. See table 2-11 for use of adapter with gage when checking for defective control valve.

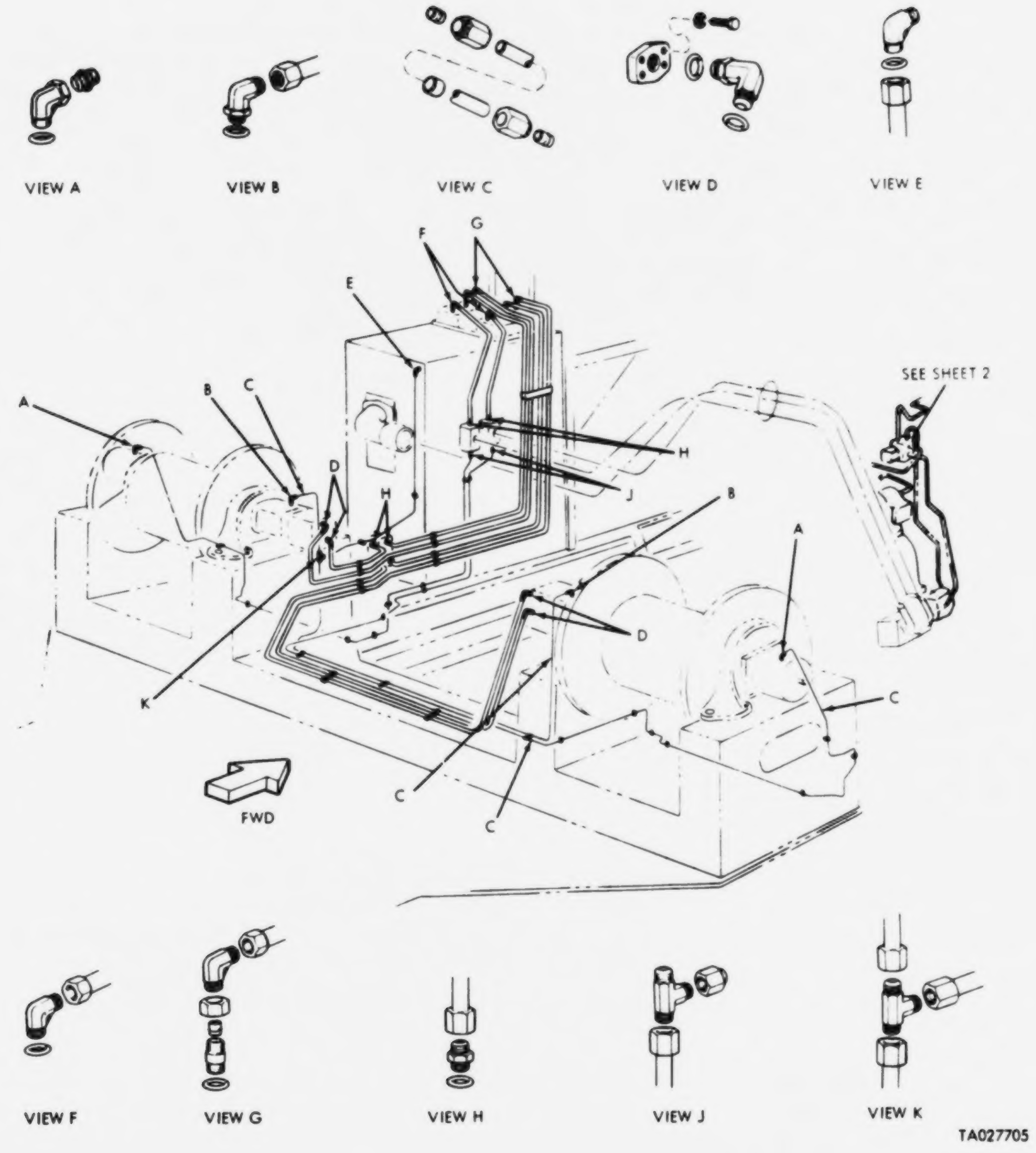

VIEW A
VIEW B
VIEW C
VIEW D
VIEW E
F
G
E
SEE SHEET 2
A
B
C
D
H
H
J
B
A
D
K
C
C
C
FWD
VIEW F
VIEW G
VIEW H
VIEW J
VIEW K
TA027705

Figure 2-267. Winch hydraulic lines and fittings (1 of 2).

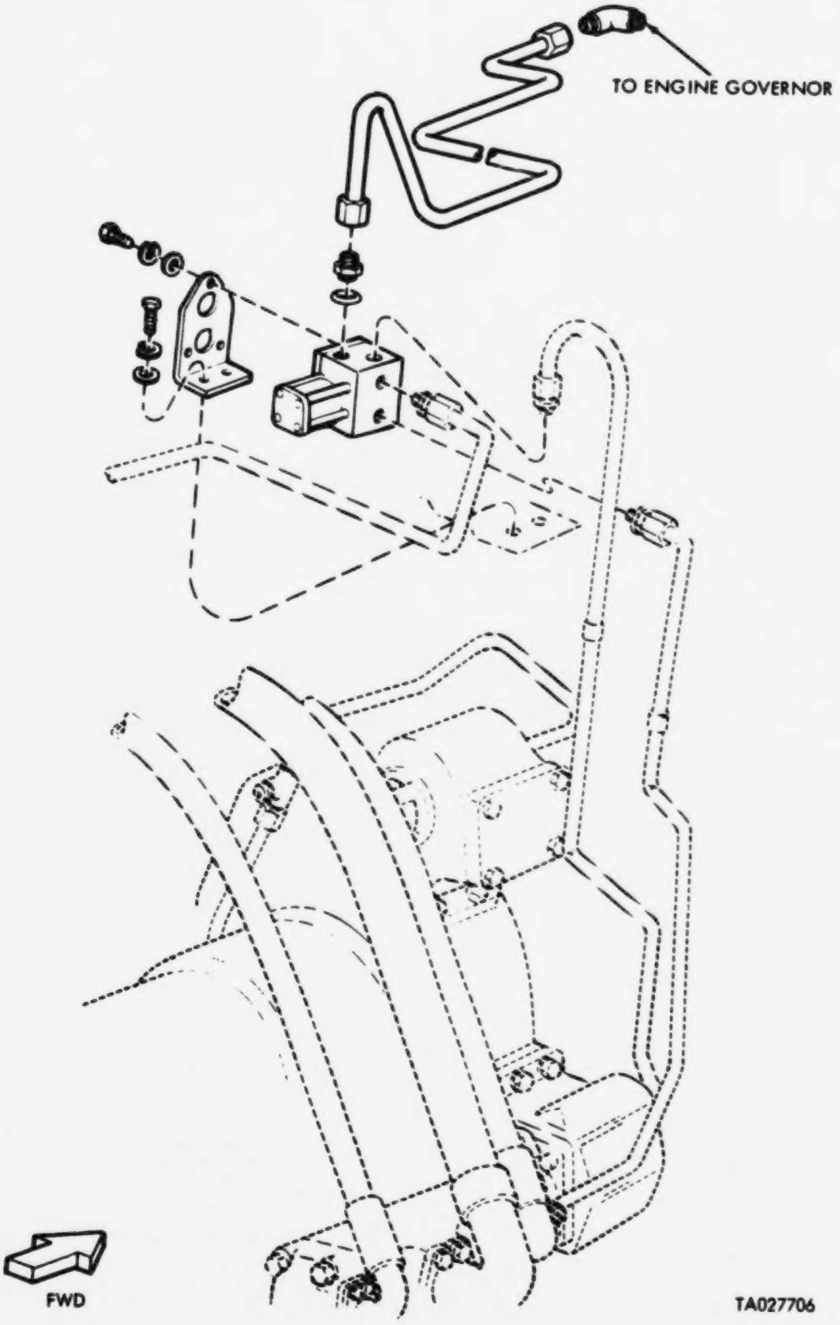
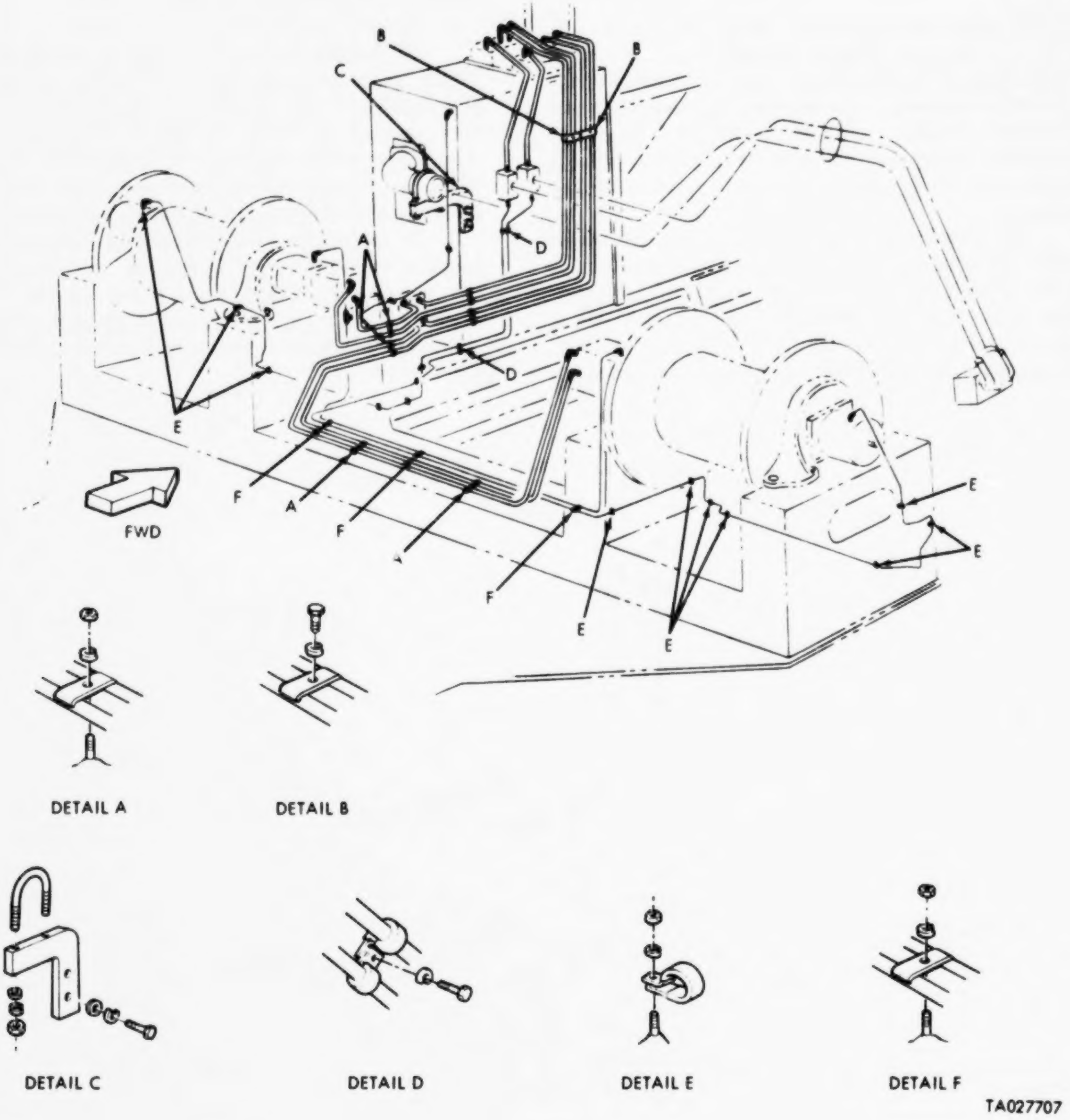

TO ENGINE GOVERNOR
FWD
TA027706

Figure 2-267. Winch hydraulic lines and fittings (2 of 2).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E
F
A
F
A
F
E
E
FWD
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
TA027707

Figure 2-268. Winch hydraulic lines, clamps and straps.

2-173. Winch Hydraulic Valves

Figs 2-269 through 2-271

a. Replace Anti-Cavitation Valves (fig. 2-269)

(1) Removal. Disconnect tubing at valve connections. Remove fittings and packing from valves. Remove two screws securing valves to mounting bracket. Remove valves and spacer. If mounting bracket is damaged, remove and replace bracket. Unless new valves are immediately instlled, plug tubing to prevent comtaminants from entering.

(2) *Installation.* Unplug tubing unless new valves were immediately installed. If mountng bracket was found damaged at removal, replace prior to installing. Install valves, spacer, and two screws securing valves to mounting bracket. Attach fittings and packing to valves. Connect tubing at valve connections. Be sure to install spacer between valves. Install new packing and inspect fitting threads for damage that might allow leakage. Install fittings and connect tubing.

b. Replace Control Valves.

(1) *Removal.* Disconnect control handle (fig. 2-270) at valve by removing cotter pin from each of two pins attaching handle to valve. Disconnect tubing and remove packing (fig. 2-267). Unless valve is immediately replaced, plug tubing end to preserve cleanliness. Remove three screws and lockwashers securing each valve. Remove valve. Remove packing from valve mounting plate.

(2) *Installation.* Replace packing at valve mounting plate. Install valve with three screws and lockwashers securing each valve. Unless valve was immediately replaced, unplug tubing end. Connect tubing and replace packing. Atach handle to valve with two pins and cotter pin.

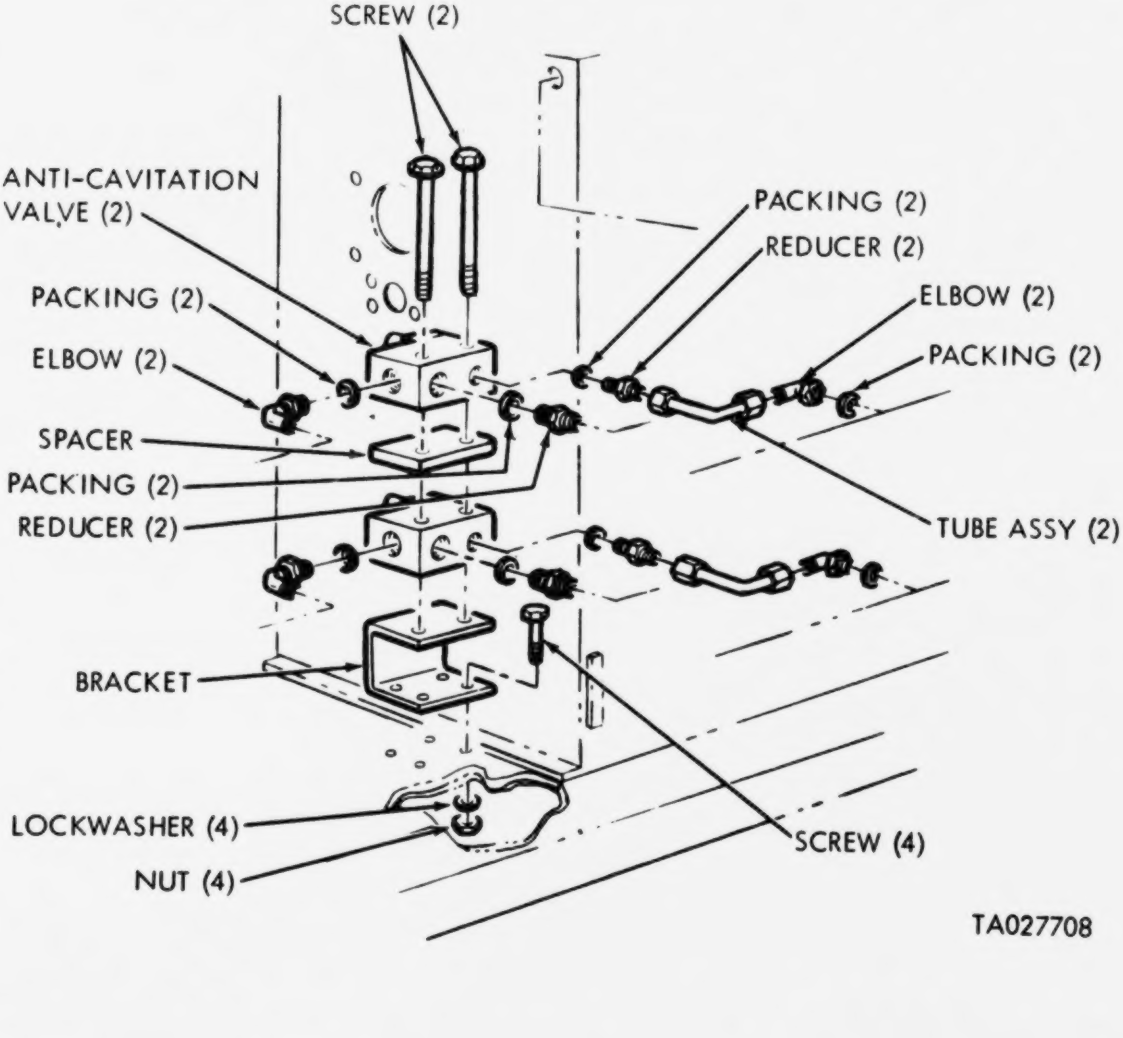

Figure 2-269. Anti cavitation valve installation.

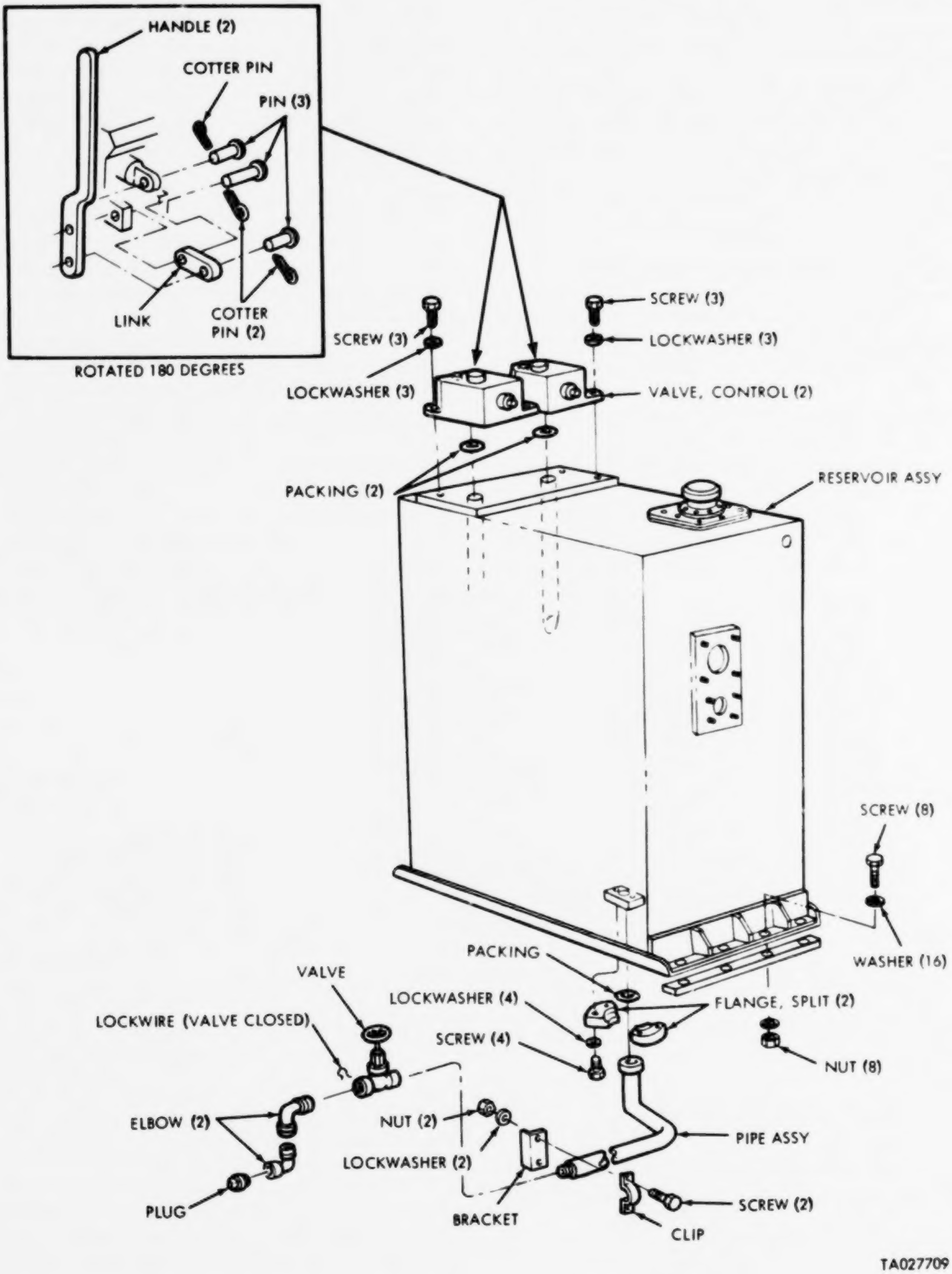
HANDLE (2)
COTTER PIN
PIN (3)
LINK
COTTER PIN (2)
ROTATED 180 DEGREES
SCREW (3)
LOCKWASHER (3)
SCREW (3)
LOCKWASHER (3)
VALVE, CONTROL (2)
PACKING (2)
RESERVOIR ASSY
SCREW (8)
WASHER (16)
PACKING
VALVE
LOCKWASHER (4)
FLANGE, SPLIT (2)
LOCKWIRE (VALVE CLOSED)
SCREW (4)
NUT (8)
ELBOW (2)
NUT (2)
PIPE ASSY
LOCKWASHER (2)
PLUG
BRACKET
SCREW (2)
CLIP
TA027709

Figure 2-270. Mounting of reservoir, reservoir drain, control valves, and control handles.

c. Replace Relief Valves (Fig. 2-271).

NOTE

The reservoir must be drained to replace relief valves.

(1) *Removal.* Remove air filter assembly. Remove 12 screws and lockwashers and cap mounting plate at oil fill. Reach in with wrench through fill hole and loosen relief valve jamnuts. Unscrew relief valves from fitting stems. Remove relief valves from reservoir. Remove packing from relief valves.

NOTE

If fittings are to be removed at this point, refer to *d* below.

(2) *Installation.* Install packing in relief valve ports. Place each relief valve in reservoir through fill hole and thread onto fitting stem. Tighten jam nut against each valve.

d. Replace Fitting.

(1) *Removal.* Disconnect discharge hoses at the reservoir (fig. 2-272). Disconnect 1-inch tubing and ⅜-inch tubing from fittings (fig. 2-267). Remove connector bodies and packing. Remove nipple. With relief valves removed from reservoir (*c* above), remove relief valve jamnuts. Loosen and remove fitting jam nuts from fitting stems (fig. 2-271). Unscrew each fitting from reservoir and remove packing from each fitting.

(2) *Installation.* Install packing on fitting stems and thread fitting stems onto reservoir mounting plate. Install jamnuts on fitting stems inside reservoir through fill hole. Tighten jamnuts when fittings are alined parallel to each other. Install nipples on fitting pump discharge inlet ports. Install packing and install connector bodies on upper and lower outside ports of fittings. Install 1-inch and ⅜-inch tubing. Connect discharge hose.

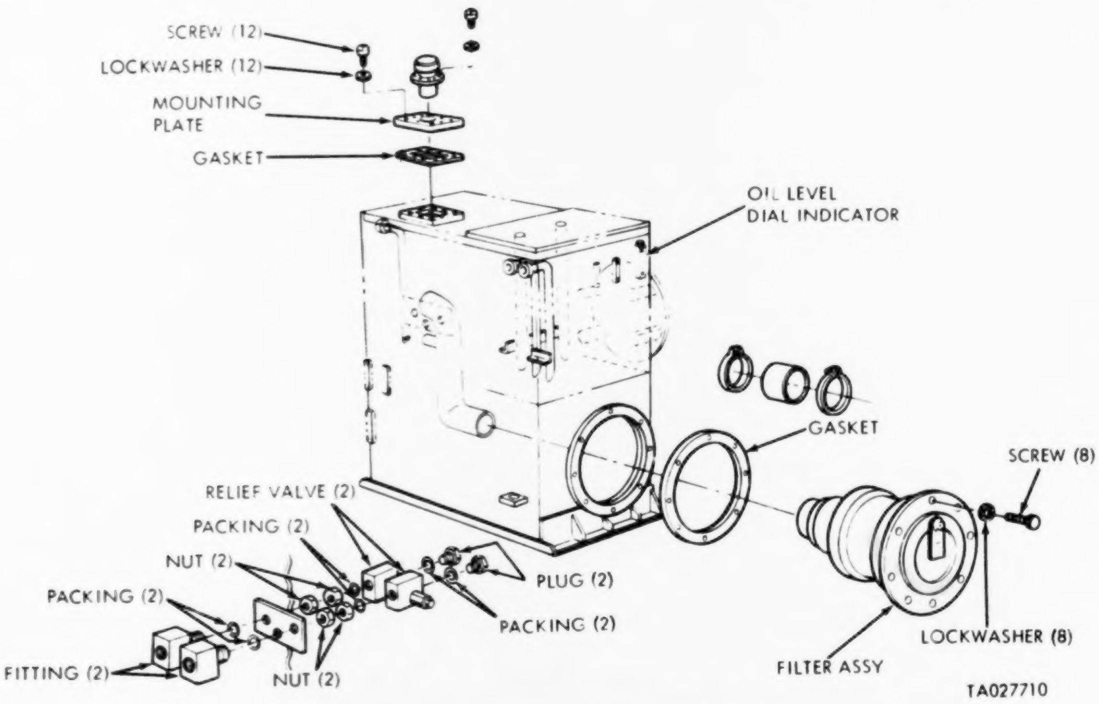

Figure 2-271. Reservoir assembly — exploded view.

2-174. Winch Control Handles

Fig. 2-270

a. Removal. Remove cotter pins from pins securing handle and crank to valve. Remove pins. Remove handles.

b. Installation. Position handles, install pins, and insert cotter pins securing handle with crank to valve.

2-175. Reservoir Assembly

a. General. The reservoir assembly consists of reservoir, hydraulic fluid filter assembly, relief valves and fittings, fill cap and air filter assembly, and various parts welded internally and externally.

b. Replace Reservoir (fig. 2-270).

(1) *Removal.* After draining reservoir (para 2-169), disconnect tubing and hoses at reservoir fittings and control valves. Remove winch guard support (para 2-179). Remove power steering pump supply line elbow from reservoir. Remove elbow at winch pump supply port on reservoir. Remove control valves and packing. Remove drain line. Remove PTO switch and engine throttle control mounting bracket on forward wall of

reservoir. Remove clamps securing tubing to reservoir wall. Remove eight nuts, 16 lockwashers, and eight screws securing reservoir to deck. Remove reservoir.

(2) *Installation.* Position and secure reservoir to deck with eight nuts, 16 lockwashers, and eight screws. Install PTO switch and engine throttle control mounting bracket on forward wall of reservoir. Attach drain line and elbow at winch pump supply port on reservoir. Attach winch guard support, tubing, and hoses at reservoir fittings and control valves. Fill reservoir.

2-176. Winch Hydraulic Pump

Fig. 2-272

a. Removal.

(1) Detach three hoses at reservoir.

(2) Use socket wrench with extension and loosen two screws securing pump to power takeoff (fig. 2-272.) To facilitate removal, position one man at ground level to guide socket onto screw caps. Do not remove bolts until rope sling has been attached to pump lifting bracket. Take up slack in rope.

(3) Remove two screws and lockwashers securing pump to PTO. Pull pump straight back from PTO until PTO shaft is free of pump. Remove pump from vehicle taking care that hoses do not get caught in transit.

(4) Drain oil from hoses into suitable container.

(5) Tag hose at PTO end for correct reinstallation. Remove four screws, lockwashers, and double flange at each hose connection of pump. Remove and discard packing at each pump port and remove pump lifting bracket.

b. Installation.

(1) Install hoses at correct pump ports using new packing, double flange, and four screws and lockwashers at each port. Install pump lifting bracket at supply hose port.

(2) Use suitable lifting device and position pump in line with PTO. Push pump femal coupling onto PTO drive shaft.

(3) Use socket wrench with extension to install two screws and lockwashers to secure pump to PTO flange.

(4) Reconnect three hoses.

c. Replacement of Pump Hoses. Disconnect hose(s). Drain oil from hose(s) into suitable container. Remove supply hose from nipple attached. Disconnect hose(s) at pump (*a*(5) above) and remove from vehicle. For installation, use new packing and connect hose(s) at pump (*a*(5) above). Join supply hose to nipple attached and connect hose(s). Remove container used to drain oil from hose(s).

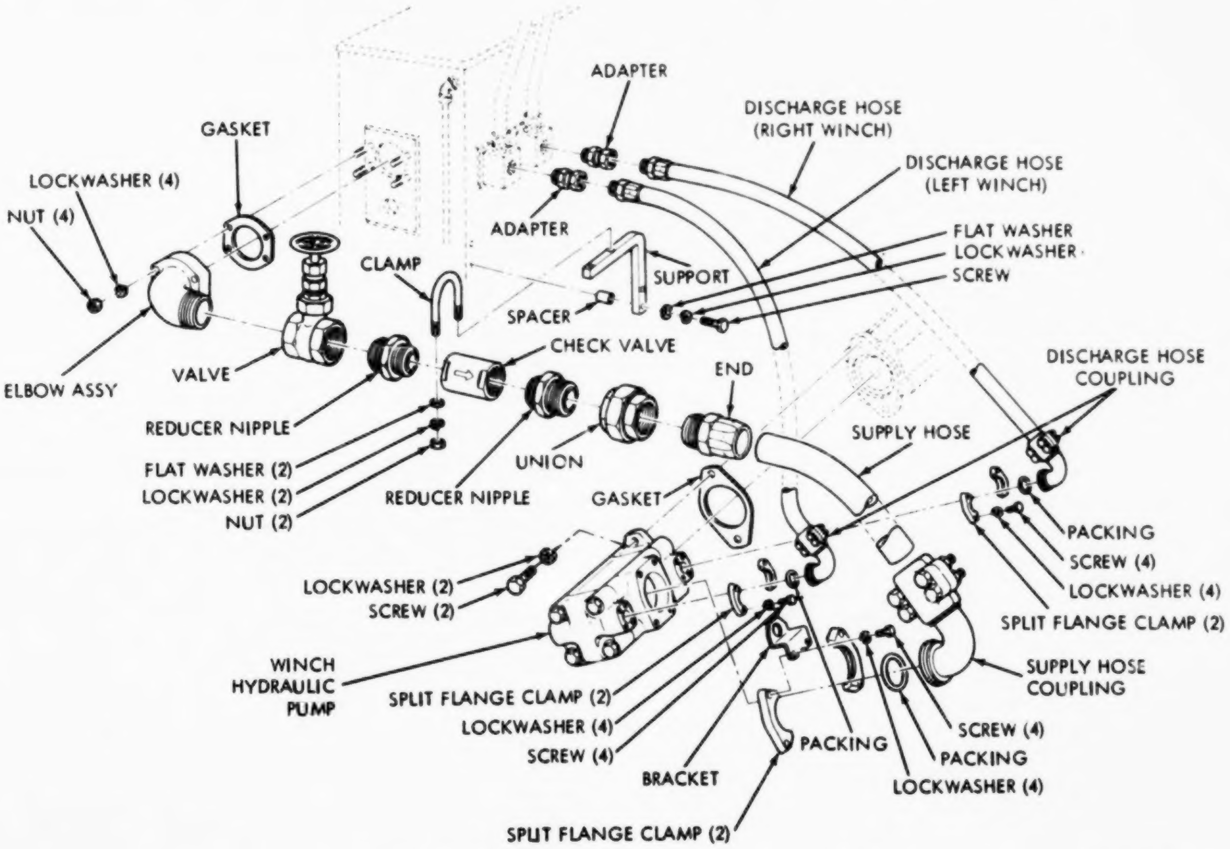
ADAPTER
DISCHARGE HOSE (RIGHT WINCH)
GASKET
DISCHARGE HOSE (LEFT WINCH)
LOCKWASHER (4)
NUT (4)
ADAPTER
FLAT WASHER
LOCKWASHER
SCREW
CLAMP
SUPPORT
SPACER
CHECK VALVE
DISCHARGE HOSE COUPLING
END
ELBOW ASSY
VALVE
REDUCER NIPPLE
SUPPLY HOSE
UNION
FLAT WASHER (2)
LOCKWASHER (2)
NUT (2)
REDUCER NIPPLE
GASKET
PACKING
SCREW (4)
LOCKWASHER (4)
LOCKWASHER (2)
SCREW (2)
SPLIT FLANGE CLAMP (2)
WINCH HYDRAULIC PUMP
SUPPLY HOSE COUPLING
SPLIT FLANGE CLAMP (2)
LOCKWASHER (4)
SCREW (4)
SCREW (4)
PACKING
PACKING
BRACKET
LOCKWASHER (4)
SPLIT FLANGE CLAMP (2)

Figure 2-272. Winch hydraulic pump and supply and discharge hoses.

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2-177. Winch Hydraulic Motor

Fig. 2-273

a. Removal.

(1) Disconnect and plug three hydraulic lines at motor. Catch fluid runoff in suitable container. Remove three elbows and packing.

(2) Remove four screws and lockwashers securing motor to winch. Remove motor and gasket.

(3) Remove eight screws and lockwashers and remove two flanges and flange packing. Remove pin and remove spool from motor. Remove coupling pin and coupling from motor.

(4) If winch is to be removed, refer to para 2-178.

b. Installation.

(1) Install two flanges and flange packing on motor using eight screws and lockwashers.

(2) Position coupling on motor drive shaft and aline pin holes in coupling and shaft. Install pin. Position spool on coupling and aline pin holes in spool in coupling. Install pin.

(3) Position motor with gasket in winch so that spool teeth aline with gear teeth in winch. Install motor using four screws and lockwashers.

(4) Install three new packing and three elbows in motor. Aline elbows with tube assemblies and connect tube assemblies to elbows.

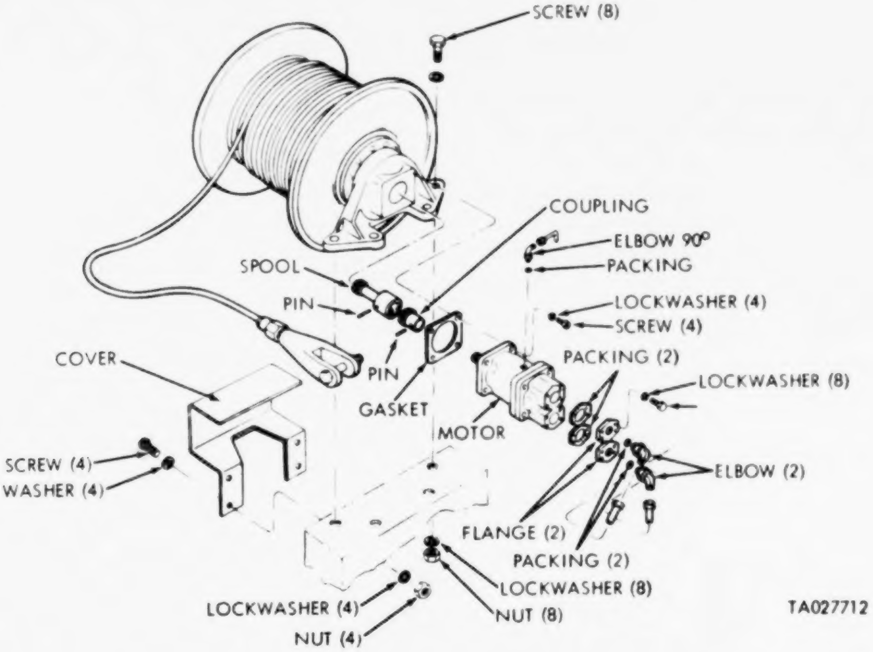


Figure 2-273. Removal or installation of winch and winch hydraulic motor.

2-178. Winch

a. Removal (fig. 2-273).

(1) If cable is to be reused and winch discarded, remove cable (para 2-167).

(2) Remove hydraulic motor (para 2-177).

(3) Remove two cover screws, washers, lockwashers, and nuts. Remove cover. Disconnect and plug hydraulic tube at winch brake connection. Remove elbow and packing. Remove eight screws, 16 lockwashers, and eight nuts securing winch.

(4) Remove eight nuts, lockwashers, and screws securing winch to winch supports. Using suitable lifting device, remove winch from vehicle.

b. Installation.

(1) Use suitable lifting device and position winch on winch supports. Secure winch to supports using eight screws, lockwashers, and nuts.

(2) Install new packing and elbow at brake control hydraulic port. Aline elbow with tube assembly and connect tube assembly to elbow. Install cover using four screws, washers, lockwashers, and nuts.

(3) Install hydraulic motor (para 2-177*b*).

(4) Fill reservoir (para 2-171*b*).

(5) Install cable on winch.

2-179. Winch Guard Support

Fig. 2-274

Replace winch guard support as required. The support is mounted to the reservoir by eight screws and lockwashers.

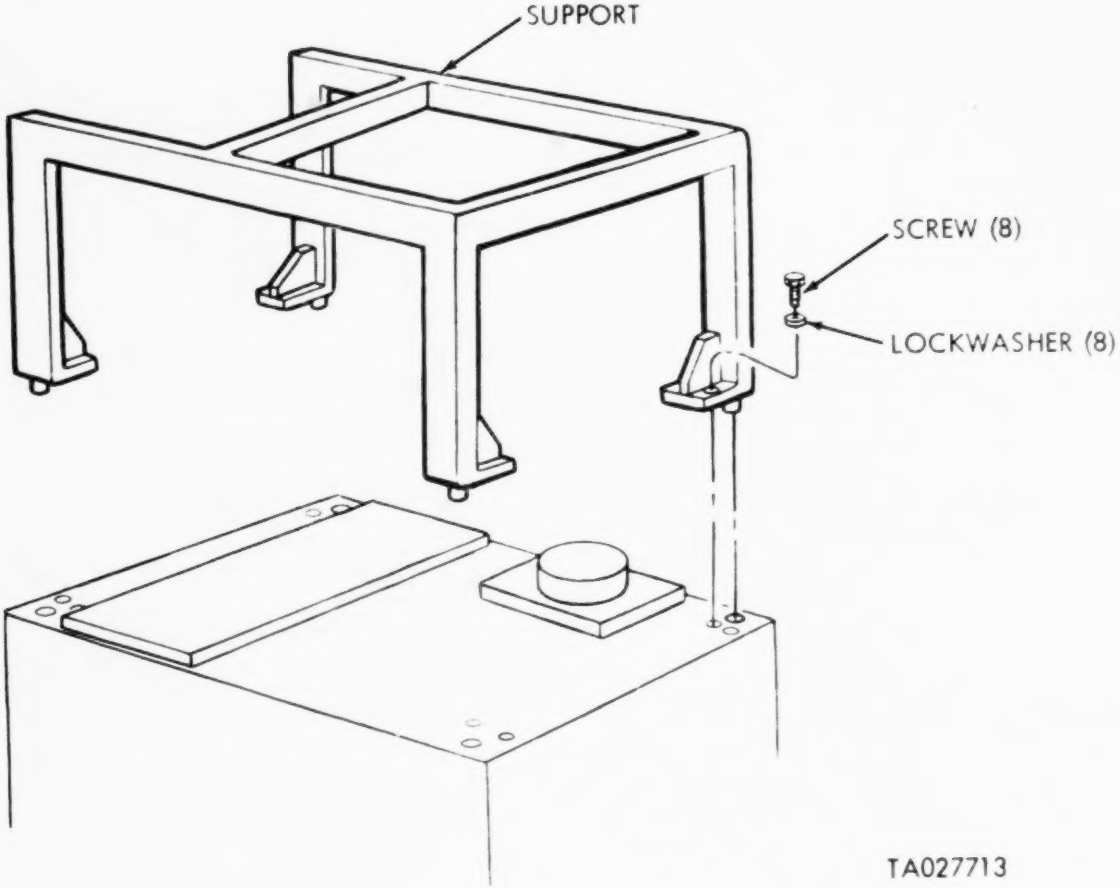


Figure 2-274. Removal or installation of winch guard support.

Section XXVII. PERSONNEL HEATER AND WINDSHIELD DEFROSTER SYSTEM

2-180. Personnel Heater System

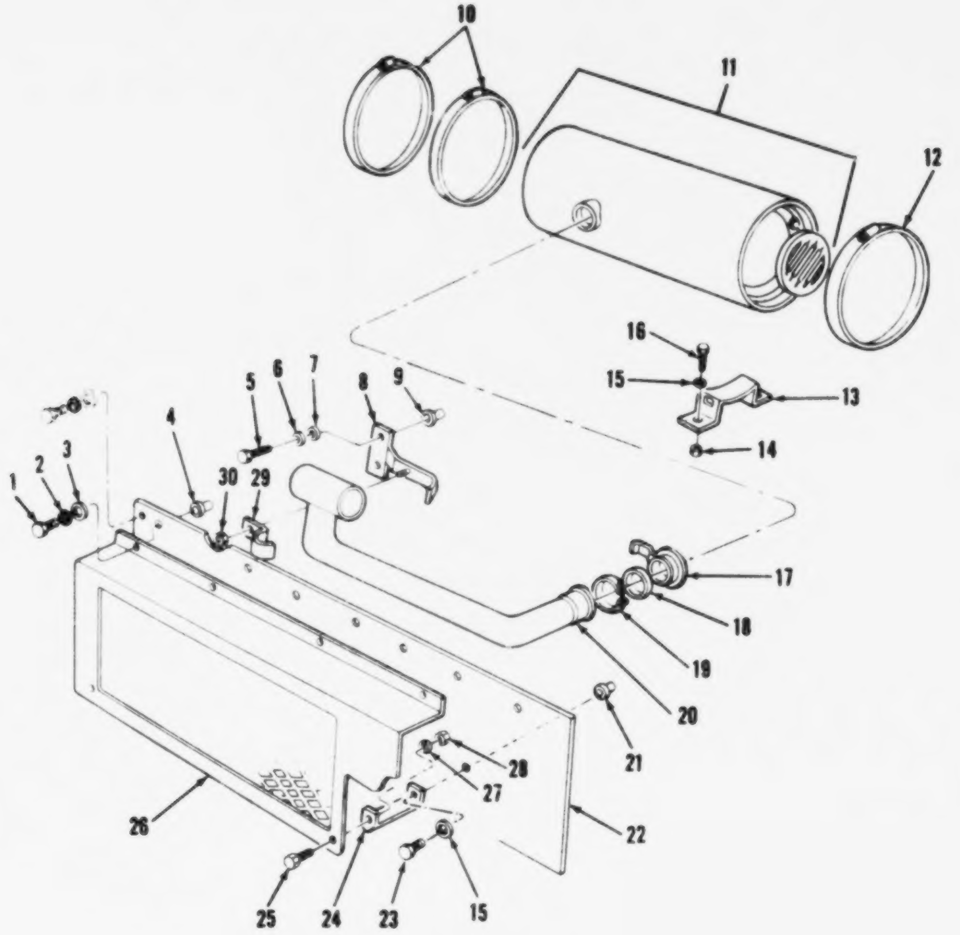
Fig. 2-275

a. Removal. Remove four screws (1), lockwashers (2), washers (3), two screws (25), lockwashers (27), and nuts (28). Remove guard (26). Disconnect four screws and washers and remove cover assembly (22). Disconnect hose assembly (11, fig. 2-276) from union (8, fig. 2-276). Disconnect tube assembly (1, fig. 2-276) from tee (15, fig. 2-276). Caefully remove access panel from cab rear wall (para 2-163). Filter may be left on panel. Remove nut (30) and clamp (29) so that exhaust tube is unattached to cab frame. Disconnect heater from duct work. Remove screws in clamps (10 and 12) and unfasten clamps. Remove heater with exhaust tube from vehicle. Remove exhaust tube from heater.

b. Installation. Assemble exhaust tube to heater and position on vehicle. Fasten clamps (10 and 12) with screws. Connect heater to duct work. Attach nut (30) and clamp (29) to secure exhaust tube to cab frame. Carefully attach panel to cab rear wall and connect tube assembly (1, fig. 2-276) to tee (15, fig. 2-276). Connect hose assembly (11, fig. 2-276) to union (8, fig. 2-276). Attach cover assembly (22) with four screws and lockwashers. Attach guard (26) with four screws (1), lockwashers (27) and nuts (28).

c. Replacement of Personnel Heater Fuel Lines, Fuel Pump or Filter Assembly (figs. 2-276 and 2-777). Refer to figure 2-276 and replace fuel lines, fittings, clamp, pump, or filter as required.

d. Replacement of Personnel Heater Tube and Duct Work (fig. 2-277). Refer to figure 2-277 and replace personnel heater tube and duct work as required.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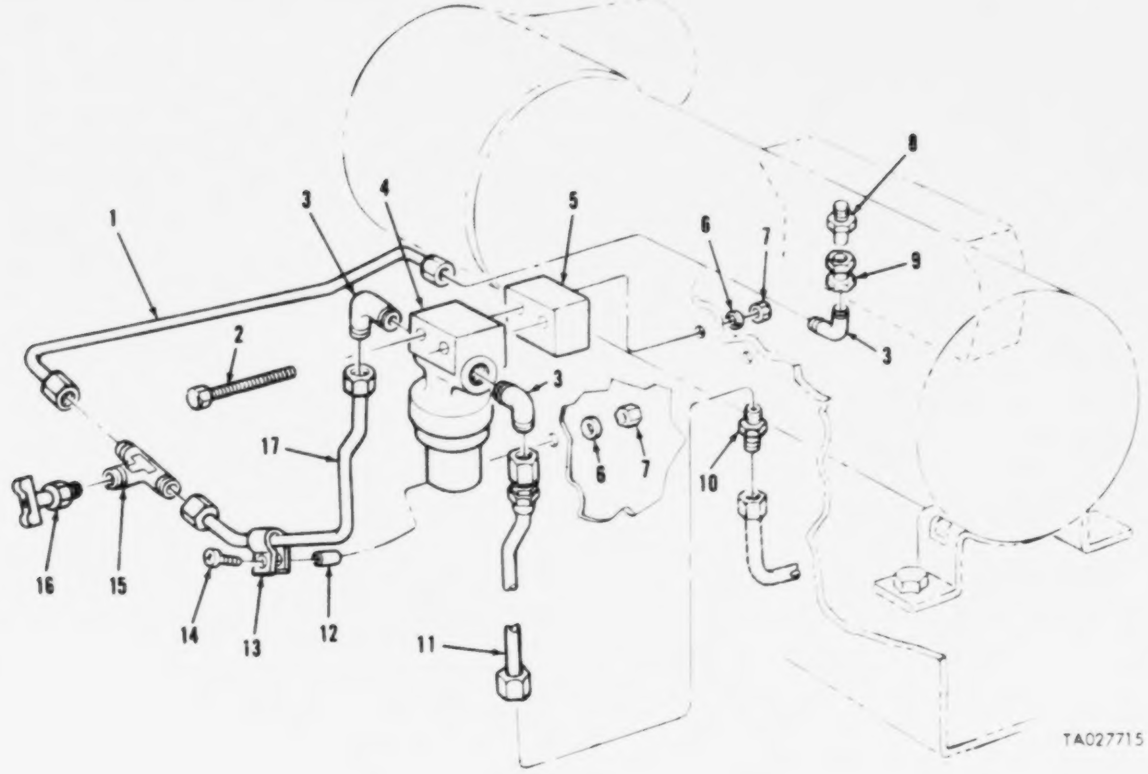
1 Screw (4)
2 Lockwasher (4)
3 Washer (4)
4 Nut (4)
5 Screw (2)
6 Lockwasher (2)
7 Washer (2)
8 Bracket
9 Nut (2)
10 Clamp (2)
11 Heater assembly
12 Clamp
13 Bracket (2)
14 Nut (4)
15 Lockwasher (6)
16 Screw (4)
17 Retainer
18 Sleeve
19 Coupling
20 Tube
21 Nut (2)
22. Cover assembly
23 Screw (2)
24 Brace (2)
25 Screw (2)
26 Guard
27 Lockwasher (2)
28 Nut (2)
29 Clamp
30 Nut

Figure 2-275. Personnel heater, exhaust tube, and tube and filter guard.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TA027715

1 Tube
2 Screw (2)
3 Elbow (2)
4 Fuel filter
5 Mounting block
6 Washer (3)
7 Nut (3)
8 Union
9 Coupling
10 Nipple
11 Hose
12 Spacer, mounting
13 Clamp
14 Screw
15 Tee
16 Drain valve
17 Tube assembly

Figure 2-276. Personnel heater fuel system (1 of 2).

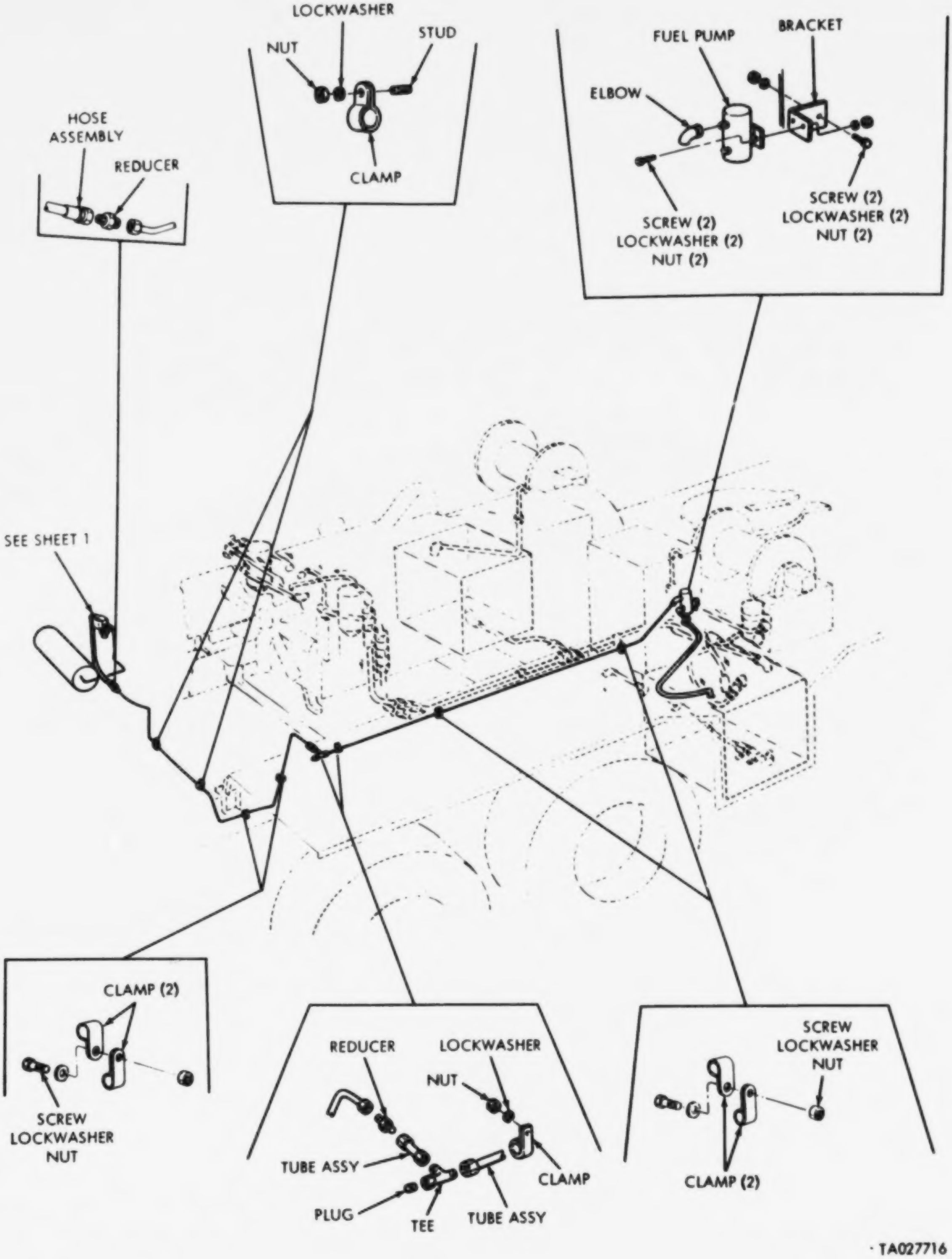
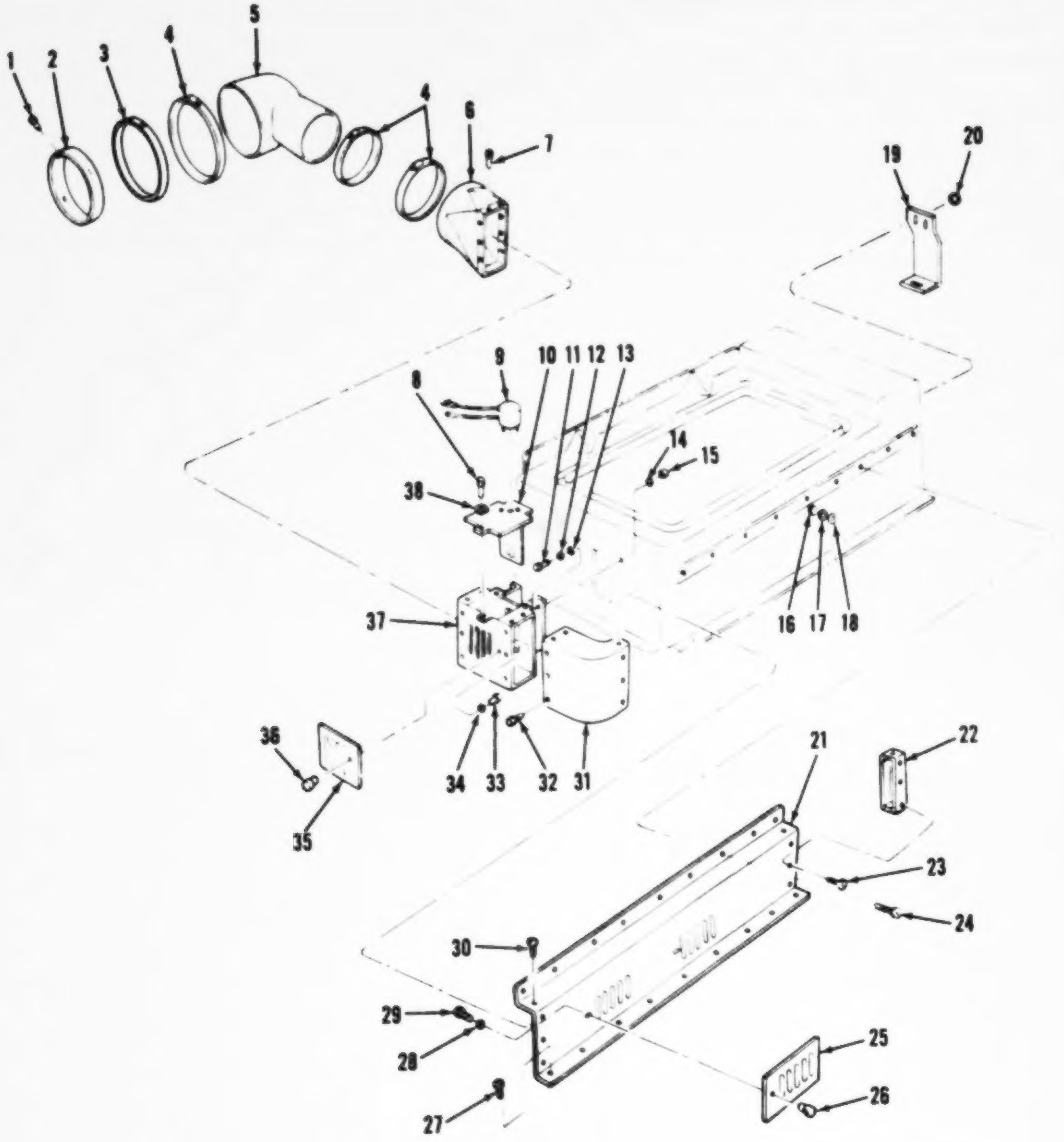

LOCKWASHER
NUT
STUD
CLAMP
HOSE ASSEMBLY
REDUCER
FUEL PUMP
BRACKET
ELBOW
SCREW (2)
LOCKWASHER (2)
NUT (2)
SCREW (2)
LOCKWASHER (2)
NUT (2)
SEE SHEET 1
CLAMP (2)
SCREW
LOCKWASHER
NUT
REDUCER
LOCKWASHER
NUT
TUBE ASSY
CLAMP
PLUG
TEE
TUBE ASSY
SCREW
LOCKWASHER
NUT
CLAMP (2)
TA027716

Figure 2-276. Personnel heater fuel system (2 of 2).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TA027717

1 Screw (4)
2 Tube
3 Clamp
4 Clamp (3)
5 Tube, elbow
6 Duct
7 Screw (8)
8 Screw (3)
9 Solenoid, battery heat
10 Damper assembly
11 Screw
12 Washer
13 Washer
14 Lockwasher
15 Nut
16 Nut (9)
17 Lockwasher (9)
18 Washer (9)
19 Deflector
20 Washer
21 Duct
22 Cover
23 Screw (4)
24 Screw (9)
25 Door
26 Knob
27 Screw (9)
28 Lockwasher
29 Screw
30 Screw (4)
31 Duct, elbow
32 Screw (4)
33 Screw
34 Lockwasher
35 Door
36 Knob
37 Duct assembly
38 Lockwasher (3)

Figure 2-277. Personnel heater tube and duct work.

2-181. Windshield Defroster System

(Figs. 2-278 and 2-279).

a. Replacement of Blower (Fig. 2-278).

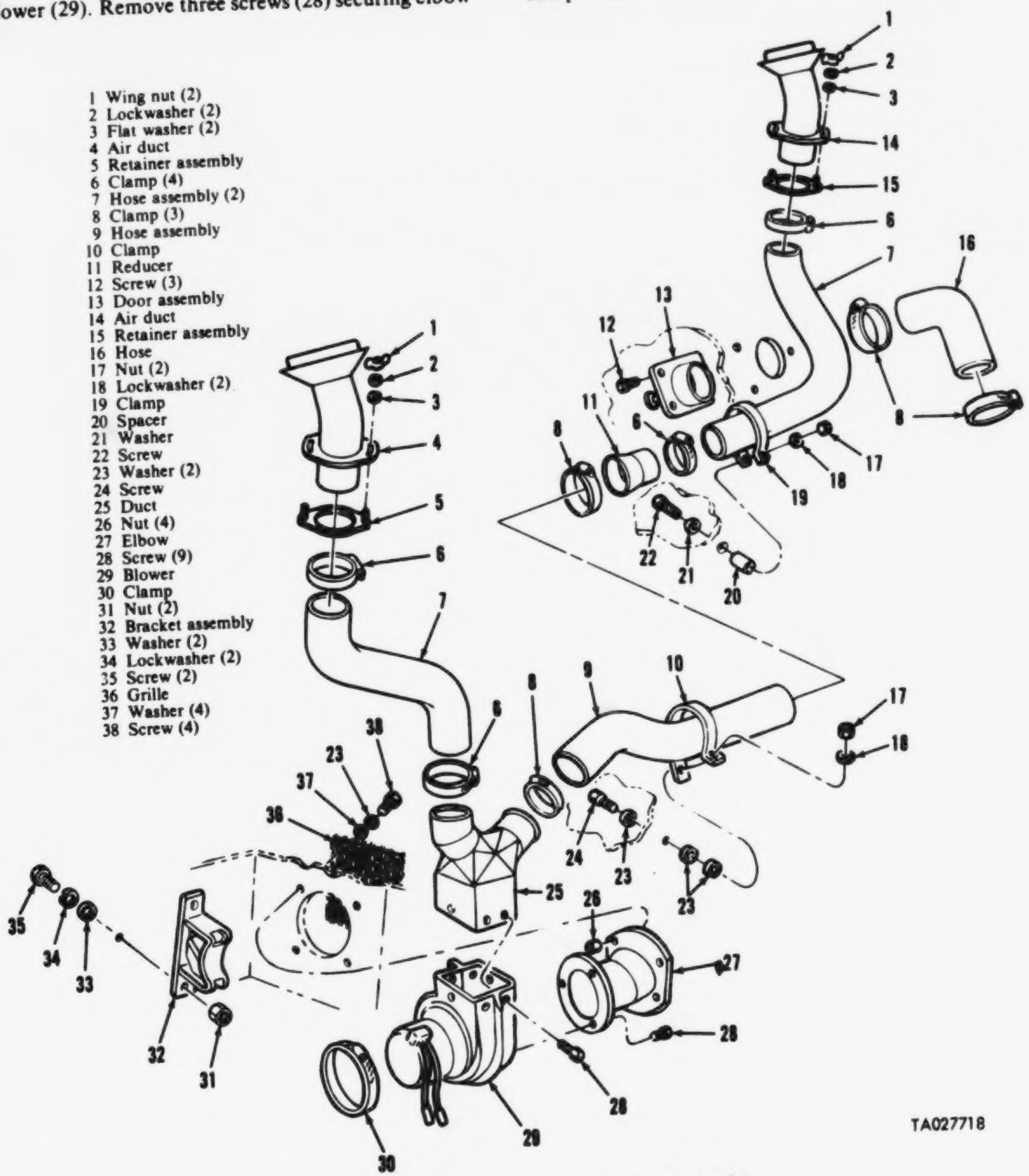
NOTE

Procedures for both left and right blower are the same. Refer to figure 2-279 for right side defroster system components.

(1) *Removal.* Disconnect and unclamp electrical leads. Remove six screws (28) securing upper duct (25) to blower (29). Remove three screws (28) securing elbow (27) to blower (29). Remove screw in clamp (30) and unfasten clamp. Remove blower (29).

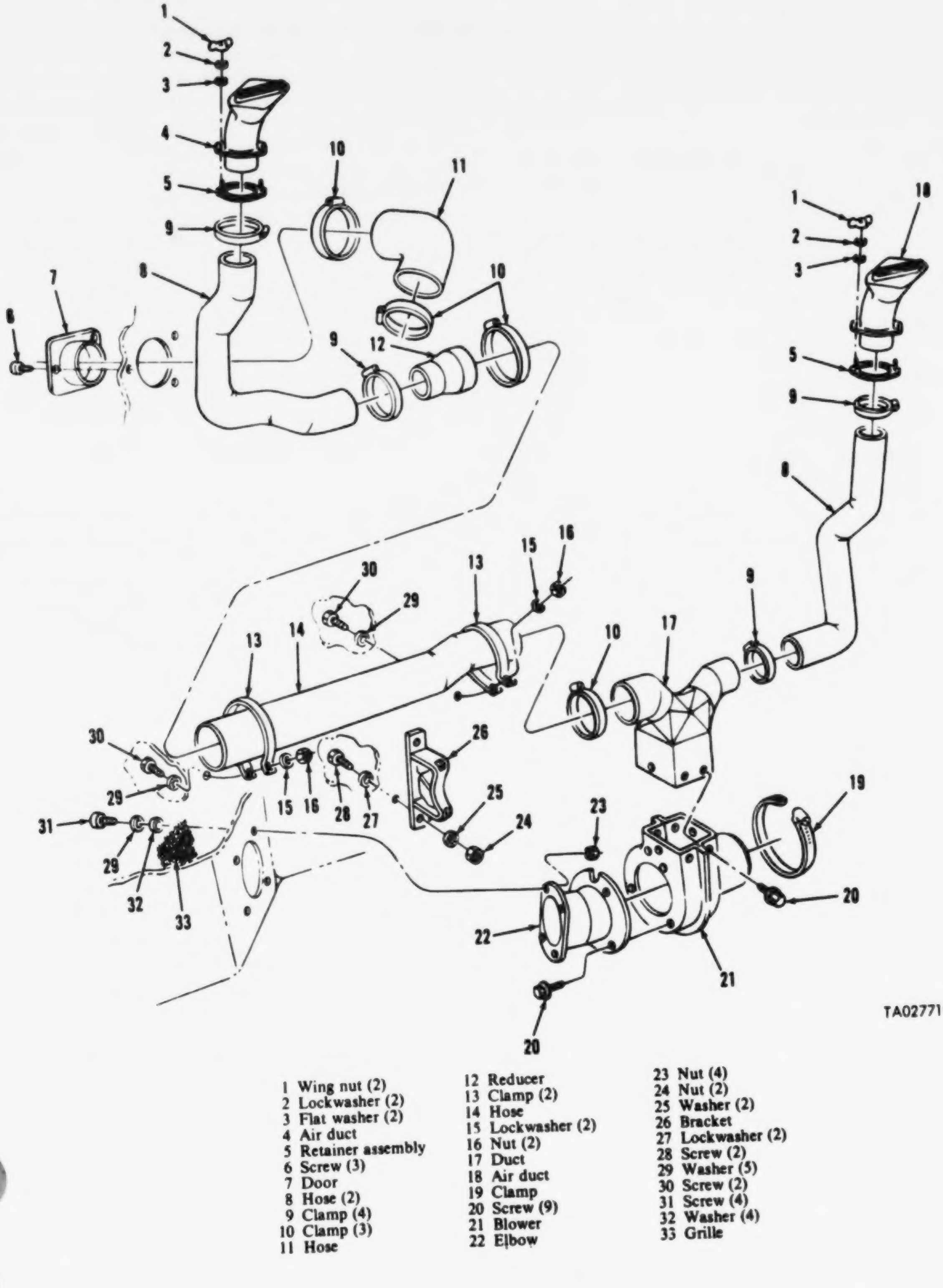
(2) *Installation.* Position blower and fasten clamp with screw (30). Attach three screws (28) securing elbow (27) to blower (29). Attach six screws (28) securing upper duct (25) to blower (29). Connect and clamp electrical leads.

b. Replace Defroster System Ductwork. Refer to figures 2-278 and 2-279 and replace defroster duct work components as required.


1 Wing nut (2)
2 Lockwasher (2)
3 Flat washer (2)
4 Air duct
5 Retainer assembly
6 Clamp (4)
7 Hose assembly (2)
8 Clamp (3)
9 Hose assembly
10 Clamp
11 Reducer
12 Screw (3)
13 Door assembly
14 Air duct
15 Retainer assembly
16 Hose
17 Nut (2)
18 Lockwasher (2)
19 Clamp
20 Spacer
21 Washer
22 Screw
23 Washer (2)
24 Screw
25 Duct
26 Nut (4)
27 Elbow
28 Screw (9)
29 Blower
30 Clamp
31 Nut (2)
32 Bracket assembly
33 Washer (2)
34 Lockwasher (2)
35 Screw (2)
36 Grille
37 Washer (4)
38 Screw (4)

TA027718

Figure 2-278. Defroster system components (left side).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TA027719

1 Wing nut (2)
2 Lockwasher (2)
3 Flat washer (2)
4 Air duct
5 Retainer assembly
6 Screw (3)
7 Door
8 Hose (2)
9 Clamp (4)
10 Clamp (3)
11 Hose
12 Reducer
13 Clamp (2)
14 Hose
15 Lockwasher (2)
16 Nut (2)
17 Duct
18 Air duct
19 Clamp
20 Screw (9)
21 Blower
22 Elbow
23 Nut (4)
24 Nut (2)
25 Washer (2)
26 Bracket
27 Lockwasher (2)
28 Screw (2)
29 Washer (5)
30 Screw (2)
31 Screw (4)
32 Washer (4)
33 Grille

Figure 2-279. Defroster system components (right side).

Section XXVIII. MAINTENANCE UNDER UNUSUAL CONDITIONS

2-182. Lubrication

Refer to para 2-6 for lubricating requirements when vehicle is operated under unusual conditions. Refer also to LO 9-2320-258-12.

2-183. Cleaning

When operating the vehicle on secondary roads where muddy and dusty conditions prevail, it is normal to get mud or dust build up in the brake drums. To prevent rapid brake wear under such conditions, it is necessary to perform a mud build up inspection. This is accomplished by pulling the number 4 axle left brake drum and number 4 axle right brake drum on an alternating basis every 3,000 miles of operation in mud or dust, and inspect for mud build up. If there is evidence of mud build up on the drum, brake return springs, and brake actuators, remove all drums and clean the surfaces by careful washing and chipping.

APPENDIX A
REFERENCE

A-1. Publication Indexes

The following indexes should be consulted frequently for latest changes or revisions and for new publications relating to material covered in this technical manual.

Index of Administrative Publications	DA Pam 310-1
Index of Blank Forms	DA Pam 310-2
Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders	DA Pam 310-4
U.S. Army Equipment Index of Modification Work Orders	DA Pam 310-7

A-2. Forms

Refer to TM 38-750, The Army Maintenance Management Systems (TAMMS), for instructions on the use of maintenance forms pertaining to this materiel.

A-3. Publications

a. Maintenance.

Basic Cold-Weather Manual	FM 31-70
Camouflage	FM 5-20
Painting Operations, Instructions for Field Use	TM 43-0139
Inspection, Care, and Maintenance of Antifriction Bearings	TM 9-214
Lubrication Order for Truck Tractor, 22½ ton, 8 x 8, M746	LO 9-2320-258-12
Organizational Maintenance Repair Parts and Special Tools List for Truck, Tractor, 22½ ton, 8 x 8, M746	TM 9-2320-258-20P
Organizational Care, Maintenance and Repair of Pneumatic Tires and Inner Tubes	TM 9-2610-200-20
Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use	TM 750-244-6
Ordnance Tracked and Wheeled Vehicle Hull and Chassis Wiring; Repair of Cracked or Peeled Plastic, Natural Rubber, or Synthetic Rubber-Covered Conduit Cables	TB ORD 650
Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems	TB 750-651

b. Operating Vehicle.

Northern Operations	FM 31-71
Driver Selection and Training (Wheeled Vehicles)	TM 21-300
Manual for the Wheeled Vehicle Driver	FM 21-305
Operation and Maintenance of Ordnance Materiel in Cold Weather - 0° to -65°F	TM 9-207
Operator's Manual for Truck, Tractor, 22½ Ton, 8 x 8, M746	TM 9-2320-258-10
Equipment Serviceability Criteria for Truck, Tractor, 22½ Ton, 8 x 8, M746	TM 9-2320-258-ESC

APPENDIX B
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General

The maintenance allocation chart (MAC) sets forth specific maintenance operations performed at the proper maintenance levels, on the basis of time, tools, and skills normally available to the various levels in combat situations and influenced by maintenance policy and sound maintenance practices as outlined below.

B-2. Maintenance Functions

The maintenance allocation chart designates overall responsibility for the maintenance function of an end item or assembly. Repair and/or overhaul of major assemblies is designated by authority of the Commanding Officer, except for the specific functions listed in the maintenance allocation chart. Deviation from maintenance operations allocated in the maintenance allocation chart is authorized only upon approval of the Commanding Officer. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified paramenters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accurancy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services or other maintenance actions to restore serviceability to an item by correcting specific damage fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in Column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of manhours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart.

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function. These tools are found in Section III.

Section II. MAINTENANCE ALLOCATION CHART
FOR
TRUCK, TRACTOR, 22½-TON, 8x8, M746

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category*					(5) Tools and equipment
			C	O	F	H	D	
01	Power Plant	Inspect		1.0				1, 2, 3
		Test			1.8			
		Service	0.4					
		Adjust			3.8			
		Replace			19.7			
01	ENGINE							
0100	Engine	Inspect		0.6				4, 5, 6, 7, 8, 9, 10
		Test			0.4			
		Service	0.3					
		Adjust			2.5			
		Replace			3.0			
		Repair			65.0			
		Overhaul					85.0	
	Engine Mounts	Inspect		0.1				
		Replace			1.0			
0101	Block, Engine	Inspect			4.5			
		Replace					8.5	
		Repair					45.0	
	Head, Cylinder	Inspect			1.5			11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25
		Replace			10.1			
		Repair			13.0			
0102	Pulley, Crankshaft	Inspect		0.1				
		Replace			1.1			
	Damper, Vibration	Inspect			0.1			
		Replace			7.2			
	Crankshaft	Inspect				2.0		26, 27, 28, 29, 30
		Replace				3.5		
	Bearings, Crankshaft	Inspect				2.0		27
		Replace				3.5		
0103	Flywheel Assembly	Inspect				0.5		31, 32, 33
		Replace				3.2		
		Repair				1.0		
0104	Piston and Connecting Rods	Inspect				3.0		34, 35, 36, 37, 38
		Replace				21.2		
	Bearings	Inspect				2.5		27
		Replace				4.8		
0105	Camshaft	Inspect				1.5		39, 40, 41 42
		Replace				8.5		
	Valves and Tappets	Inspect			1.0			
		Adjust			1.5			
		Replace			1.7			
	Timing Gears	Inspect				0.3		
		Adjust				1.0		
		Replace				2.5		
0106	Oil Pump	Inspect			0.5			43
		Replace			2.7			
	Filter, Oil	Inspect		0.1				
		Service		1.2				
		Replace		1.2				
	Lines, External	Inspect		0.1				
		Service		0.2				
		Replace		1.0				
	Valve, Breather	Inspect		0.2				
		Service		0.2				
		Replace		0.2				

*The subcolumns are as follows:
C - operator/crew H - general support
O organizational D - depot
F - direct support

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
	Coolers, Oil	Inspect		0.2				
		Replace			3.0			
		Repair			15.0			
	Level Gage	Inspect		0.1				
		Service	0.2					
		Replace		0.5				
	Oil Pan	Replace			3.0			
		Repair			2.0			
	Valve, Regulator and Relief	Inspect			0.1			
		Replace			0.2			
		Repair				0.2		
0108	Manifolds	Inspect		0.1				
		Replace			1.4			
0109	Accessory Drive	Inspect		0.1				
		Replace			2.0			
03	FUEL SYSTEM							
0301	Injector Assembly, Fuel	Inspect			0.2			44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56
		Adjust			0.3			
		Calibrate			0.8			
		Replace			1.0			
		Repair				0.8		
		Overhaul				0.8		
0301	Rack, Fuel Injector	Inspect			0.2			
		Adjust			0.2			
		Replace			1.3			
0302	Pump Assembly, Fuel	Inspect			0.2			57, 58
		Replace			1.5			
		Repair			1.0			
	Pump, Auxiliary	Inspect		0.1				
		Replace		0.6				
		Repair			1.4			
	Lines and Fittings, Engine Fuel	Inspect		0.1				
		Replace			1.5			
0304	Air Cleaner Assembly	Inspect	0.4					
		Service	1.2					
		Replace		1.0				
		Repair		1.2				
	Air Cleaner Indicators	Inspect	0.2					
		Replace		0.8				
0305	Turbocharger	Inspect			0.2			
		Replace			1.5			
		Repair				3.0		
	Air Inlet	Inspect		0.1				
		Replace			1.0			
	Blower, Gear Driven	Inspect		0.1				59, 60, 61, 62
		Replace			7.9			
		Repair				3.5		
	Blower, Drive	Inspect			0.1			59, 61, 62
		Replace			6.0			
0306	Tanks, Fuel	Inspect		0.1				
		Service	1.3					
		Replace		2.8				
		Repair			4.3			
	Lines and Fittings, Fuel	Inspect		0.1				63
		Replace		0.8				
0308	Governor	Inspect		0.1				64, 65, 66, 67, 68
		Adjust			1.0			
		Replace			7.5			
		Repair			2.0			
0309	Fuel Filter	Inspect		0.2				
		Service		0.6				
		Replace		0.3				

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
0311	Ether Kit, Engine Starting	Inspect	0.1					
		Service	0.2					
		Replace		1.0				
		Repair			1.5			
0312	Accelerator and Throttle	Inspect		0.2				
		Adjust		0.3				
		Replace		0.5				
04	EXHAUST SYSTEM							
0401	Exhaust Pipes	Inspect	0.1					
		Replace		0.3				
05	COOLING SYSTEM							
0501	Radiator	Inspect	0.2					
		Service	0.2					
		Replace		2.4				
		Repair			2.0			
0502	Shroud, Radiator	Inspect	0.1					
		Replace		1.5				
		Repair			2.0			
0503	Thermostats	Inspect		0.1				69, 70
		Replace		1.2				
	Hoses	Inspect	0.1					
		Replace		0.4				
	Manifolds, Water	Inspect	0.1					
		Replace			1.4			
0504	Pump, Water	Inspect		0.1				70, 71, 72
		Replace			2.2			
		Repair			1.5			
0505	Fan	Inspect		0.1				
		Replace		0.6				
		Repair			1.0			
	Belts, Fan Drive	Inspect		0.1				
		Adjust		0.2				
		Replace		1.7				
	Drive, Fan	Inspect		0.6				
		Replace		0.5				
		Repair			1.0			
06	ELECTRICAL SYSTEM							
0601	Alternator	Inspect		0.1				
		Test		0.4				
		Replace		1.3				
	Belts, Drive	Inspect	0.1					
		Adjust		0.4				
		Replace		1.0				
0602	Regulator	Inspect		0.1				
		Test		0.4				
		Adjust		0.4				
		Replace		0.4				
0603	Stater	Inspect		0.1				
		Test		0.4				
		Replace		2.5				
		Repair			1.8			
	Solenoid, Relay	Inspect		0.1				
		Test		0.4				
		Replace		0.3				
0607	Instrument Panel	Inspect	0.1					
		Test		1.6				
		Replace		1.5				
		Repair		0.7				
	Tachograph	Inspect		0.1				
		Replace		0.4				
0608	Switches	Inspect	0.1					
		Test		0.4				
		Replace		0.5				

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
	Slave Receptacle	Inspect		0.1				
		Replace		0.4				
		Repair			0.8			
	Turn Signal Control	Inspect	0.1					
		Test		0.4				
		Replace		0.4				
		Repair		0.6				
0609	Lights	Inspect	0.1					
		Replace		0.4				
		Repair		1.0				
0610	Units, Sending	Test		0.2				
		Replace		0.5				
0611	Switch and Relay, Horn	Test	0.2					
		Replace		0.2				
	Horn	Test	0.3					
		Replace		0.5				
		Repair		0.5				
0612	Batteries	Inspect	0.1					
		Test		0.6				
		Service	0.5					
		Replace		0.2				
		Repair				0.6		
	Box, Battery	Inspect		0.1				
		Replace		1.0				
		Repair		1.5				
	Cables, Battery	Inspect		0.1				
		Replace		0.4				
		Repair			0.8			
0613	Wiring (Minor)	Inspect		0.2				
		Test		0.5				
		Replace		1.0				
		Repair		0.9				
	Wiring Harness (Main)	Inspect		1.7				
		Test		2.6				
		Replace		3.5				
		Repair			2.0			
0615	Radio Suppression	Test		0.4				
		Replace		0.2				
07	TRANSMISSION							
0708	Torque Converter	Inspect			0.1			73, 74, 75 76, 77
		Replace			4.5			
		Repair			6.0			
		Overhaul				8.0		
0710	Transmission	Inspect		0.1				78, 79, 80, 81, 82, 83
		Service,	0.2					
		Replace			6.5			
		Repair			40.0			
		Overhaul				60.0		
0713	Retarder, Clutch Packs	Inspect				0.1		78, 79
		Replace				8.5		
		Repair				16.0		
0720	Power Takeoff	Inspect		0.1				
		Replace		1.0				
0721	Pump, Filter, Valves	Inspect		0.1				
		Replace			0.9			
		Repair			3.0			
08	TRANSFER							
0801	Transfer Assembly	Inspect		0.1				
		Service	0.2					
		Replace			3.0			
		Repair			5.0			
		Overhaul				6.0		
0804	Pumps, Strainers, Lines	Inspect		0.1				
		Service		0.3				
		Replace		0.5				

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
09	PROPELLER SHAFTS							
0900	Shaft, Assembly	Inspect		0.2				
		Service		0.5				
		Replace		1.0				
10	FRONT AXLE							
1000	Axle, Assembly	Inspect		1.0				
		Service		1.0				
		Replace			6.3			
		Repair				36.0		
		Overhaul					49.5	
1002	Differential, Front	Inspect		0.2				84, 85, 86, 87, 88, 89, 90, 91, 92, 93
		Service		1.0				
		Replace			12.0			
		Repair				8.0		
1004	Steering Knuckle	Inspect		0.3				94
		Service		0.7				
		Replace		6.2				
		Repair			11.4			
11	REAR AXLE							
1100	Axle Assembly	Inspect		0.3				
		Service		1.0				
		Replace			6.0			
		Repair				18.0		
	Shaft, Axle	Inspect		0.2				
		Replace		11.2				
1102	Differential, Rear	Inspect		0.2				84, 85, 86, 87, 88, 89, 90, 91, 92, 93
		Service		1.0				
		Replace			9.8			
		Repair				8.0		
	Lube Pump	Inspect		0.2				
		Replace		1.0				
12	BRAKES							
1201	Brake, Parking	Inspect		0.1				
		Adjust		0.3				
		Replace		1.5				
		Repair		1.0				
1202	Brake, Service	Inspect		0.1				95, 96, 97
		Adjust		0.5				
		Replace		3.0				
		Repair			4.0			
1206	Linkage, Mechanical	Inspect		0.1				
		Adjust		1.0				
		Replace		2.0				
		Repair			1.0			
1208	Lines and Fittings, Air	Inspect	0.2					
		Replace		0.6				
		Repair		1.2				
	Tanks, Air	Inspect	0.1					
		Replace		1.1				
		Repair		1.2				
	Air Chamber, Brake	Inspect	0.2					
		Replace		2.2				
		Repair		1.6				
	Wedge Assembly	Inspect		0.4				
		Adjust		0.3				
		Replace		2.0				
		Repair			2.5			
	Fail Safe Units	Inspect	0.1					
		Adjust		0.2				
		Replace		0.9				
		Repair			1.2			
	Valves	Inspect		0.2				
		Replace		1.8				
		Repair			1.5			

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
1209	Air Compressor Assembly, Including Governor and Belts	Inspect	0.3					
		Adjust		1.0				
		Replace		3.0				
1211	Lines and Couplings Trailer Brakes	Inspect	0.2					
		Replace		1.0				
		Repair		1.5				
13	WHEELS							
1311	Hub, Assembly	Inspect		0.1				
		Service		1.5				
		Adjust		1.0				
		Replace		2.3				
	Drum	Inspect		0.1				
		Replace		2.2				
		Repair			2.7			
	Bearings and Seals	Inspect		0.1				98, 99, 100, 101, 102, 103, 104, 105, 106
		Adjust		1.0				
		Replace		2.5				
	Studs and Nuts	Inspect		0.1				107
		Service		0.7				
		Replace		1.6				
1313	Tires	Inspect	0.4					108, 109, 110
		Service	0.3					
		Replace		2.1				
		Repair		1.3				
14	STEERING							
1401	Wheel, Steering	Inspect		0.1				
		Replace		0.5				
	Column, Steering	Inspect		0.1				
		Service		0.2				
		Adjust		1.4				
		Replace			2.8			
		Repair			3.5			
	Idler Arm	Inspect		0.1				
		Service		0.2				
		Align		0.3				
		Replace			2.5			
		Repair			3.2			
	Tie Rod	Inspect		0.1				
		Service		0.3				
		Align		0.4				
		Replace		1.5				
		Repair		1.0				
1407	Gear, Steering	Inspect		0.1				111
		Service		0.3				
		Replace		3.2				
		Repair			7.0			
	Unit, Power Steering	Inspect		0.2				112, 113
		Test		1.0				
		Service		0.5				
		Replace			6.0			
		Repair			8.0			
1410	Pump, Hydraulic, Main	Inspect		1.1				112, 113
		Replace			4.0			
		Repair				3.0		
	Pump, Hydraulic, Auxiliary	Inspect		0.2				
		Replace		2.0				
1411	Lines and Fittings, Hydraulic	Inspect		0.2				
		Replace		0.6				
		Repair		1.2				
1412	Cylinder, Power Steering	Inspect		0.2				
		Adjust			2.0			
		Replace			4.3			
		Repair			1.6			

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
1414	Valves, Hydraulic	Inspect		0.2				
		Test			1.0			
		Adjust			2.0			
		Replace			3.0			
		Repair			2.5			
15	FRAME AND TOWING ATTACHMENTS							
1501	Frame	Inspect			0.5			
		Repair				1.0		
1503	Pintle, Towing	Inspect		0.1				
		Service		0.2				
		Replace		0.5				
		Repair		0.7				
1504	Shackles, Towing	Inspect		0.1				
		Replace		0.5				
		Repair			1.5			
	Spare Tire Mount	Inspect		0.1				
		Replace		1.0				
		Repair			2.0			
1506	Fifth Wheel	Inspect		0.2				
		Service		0.2				
		Replace		4.0				
		Repair			2.5			
16	SPRINGS AND SHOCK ABSORBERS							
1601	Springs and Spring Seats	Inspect		0.1				
		Service		0.2				
		Replace			5.0			
		Repair				6.0		
1604	Shock Absorbers and Anchor Cables	Inspect		0.1				
		Replace			1.8			
1605	Torque Rods	Inspect			0.1			114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127
		Replace			2.0			
		Repair				3.0		
18	CAB AND BODY							
1801	Cab Mounts	Inspect		0.1				
		Replace		3.0				
		Repair			1.0			
	Cab Top	Inspect		0.1				
		Replace		1.0				
		Repair			0.4			
	Doors	Inspect		0.1				
		Replace			0.1			
		Repair			2.0			
	Steps	Inspect		0.1				
		Replace		0.3				
		Repair			0.3			
	Panels, Control and Engine Shroud	Inspect		0.1				
		Replace		0.5				
		Repair			0.3			
	Ventilators	Inspect		0.1				
		Replace		0.2				
		Repair			0.5			
	Splash Shields	Inspect		0.1				
		Replace		0.3				
		Repair			0.6			
1802	Fenders and Windshield	Inspect		0.1				128
		Replace		1.0				
		Repair			0.7			

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
1806	Seats and Cushions	Inspect		0.1				
		Replace		0.4				
		Repair			0.5			
1808	Storage Boxes, Racks, and Brackets	Inspect	0.1					
		Replace			0.8			
		Repair			0.5			
20	WINCHES							
2001	Winches	Inspect		0.2				129, 130, 131, 132
		Service		0.3				
		Adjust		0.5				
		Replace		6.5				
		Repair			7.0			
		Overhaul				16.0		
	Cables	Inspect	0.3					
		Service		1.0				
		Replace		1.5				
		Repair		1.0				
	Controls	Inspect		0.2				
		Replace		0.2				
		Repair			0.6			
	Lines and Fittings, Hydraulic	Inspect		0.2				
		Replace			1.7			
	Valves, Hydraulic	Inspect		0.2				
		Replace		2.0				
		Repair			1.5			
	Pump, Hydraulic	Inspect		0.1				
		Replace		3.0				
	Reservoir and Filter	Inspect	0.2					
		Service	0.3					
		Replace		6.0				
		Repair			8.0			
22	ACCESSORY ITEMS							
2202	Arm and Wiper	Inspect		0.1				
		Replace		0.2				
	Motor, Windshield Wiper	Inspect		0.1				
		Replace		0.4				
		Repair			0.5			
	Mirror, Rear View	Inspect	0.1					
		Replace		0.3				
		Repair			0.4			
	Windshield Washer	Inspect	0.1					
		Service	0.2					
		Replace		1.5				
2207	Heater, Personnel	Inspect		0.1				133, 134
		Test		0.2				
		Adjust						
		Replace		2.0				
0.4		Repair				1.0		
		Overhaul				4.0		
	Air Ducts	Inspect		0.1				
		Replace		1.0				
		Repair			1.5			
	Control Panel	Inspect		0.2				
		Service		0.2				
		Replace		0.8				
		Repair			0.4			

(1) Group number	(2) Component/assembly	(3) Maintenance function	(4) Maintenance category					(5) Tools and equipment
			C	O	F	H	D	
2210	Plates, Data and Instruction	Inspect		0.2				
		Replace			0.2			
33	SPECIAL PURPOSE KITS							
3301	Reusable Shipping Containers	Inspect			0.2			
		Repair			1.0			
47	GAGES, NON-ELECTRIC							
4701	Shaft, Speedometer	Inspect		0.1				
		Replace		1.6				
	Shaft, Tachometer	Inspect		0.1				
		Replace		0.8				
4702	Gages, Pressure	Inspect		0.1				
		Replace		0.5				

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

B-5. Explanation of Columns

*a. Reference Codes - Column (1):*The numeric character assigned to each tool or test equipment appears in column (1). These numbers also appear in column (5), Tools and Equipment, on the Maintenance Allocation Chart.

b. Maintenance Category - Column (2). This column shows all the categories of maintenance authorized the tool or test equipment and is indicated by an alphabetical character. The alpha character representative of the maintenance functions as follows:

O - organizational
F - direct support
H - general support
D - depot

c. Nomenclature - Column (3). This column lists the name and identifies the tool or test equipment.

d. National/NATO Stock Number - Column (4). The stock and part numbers assigned to each tool or test equipment item.

e. Tool Number. This column shows the part or reference number assigned to each tool or test equipment.

Tool or test equipment reference code	Maintenance category	Nomenclature	National NATO stock number	Tool number
		POWER PLANT TOOLS		
1	F, H	Anchor, Shackle Safety (Used with 10952220 Sling)	4030-00-133-6521	10944788-3
2	F, H	Sling, Lifting	4910-00-919-2884	10952220
3	F, H	Pins, Transmission Guide	5120-00-300-7843	CPR 109351
		ENGINE TOOLS		
4	F, H, D	Diagnostic Test Set	5120-00-706-5589	J9531-01
		CYLINDER BLOCK, Engine		
5	H, D	Gage, Cylinder Liner Depth	5210-00-023-4798	J22273
6	H, D	Master Ring Set and Cylinder Checking Gage	5210-00-165-7859	J9353
7	H, D	Adapter Plate, Engine Stand	5120-00-937-7279	J8650
8	H, D	Stand, Engine Overhaul	4910-00-051-6040	J9389-03
9	H, D	Remover, Cylinder Liner	5120-00-443-2506	J21716
10	H, D	Clamp, Holddown, Cylinder Liner	5120-00-999-8618	J21793-01
		CYLINDER HEAD, Engine		
11	H, D	Cleaner, Valve Guide	5120-00-766-2141	J5437
12	H, D	Remover, Valve Seat Insert	5120-00-999-8613	J6567-02
13	H, D	Replacer, Valve Seat Insert	5120-00-733-8876	10881873
14	H, D	Remover, Valve Guide	5120-00-733-8880	10919987
15	H, D	Remover Valve Bridge Guide, Broken	5120-00-999-8615	J7453
16	F, H, D	Compressor, Valve Spring	5120-00-733-8888	10881882
17	H, D	Installer, Valve Bridge Guide	5120-00-999-8616	J7482
19	F, H, D	Socket, Fuel Pipe, Torque Wrench	5120-00-019-5232	J8932-01
20	F, H, D	Stud, Cylinder Head Guide	4910-00-591-6634	J9665
21	H, D	Installer, Valve Guide	5120-00-999-8617	J21520
22	F, H, D	Tester, Assembly, Checking Exhaust Valve Spring		CPR109640

Tool or test equipment reference code	Maintenance category	Nomenclature	National/NATO stock number	Tool number
23	F, H, D	Fixture, Lifting, Cylinder Head	4910-00-456-7620	J22062-01
24	H, D	Tool, Engine Barring; Cylinder Head; Crankshaft, Piston Connecting Rod and Liner		CPR109724
		CRANKSHAFT, Engine		
26	H, D	Handle, Driver, Oil Seal Installer (Used with J9727 Installer)	5120-00-808-5082	J3154-1
27	H, D	Attachment, Micrometer Ball	5210-00-494-1738	J4757
28	H, D	Installer, Oil Seal, Crankshaft Rear	5120-00-999-8619	J9727
29	H, D	Installer, Oil Seal, Crankshaft, Front	5120-00-936-4377	J9783
30	H, D	Expander, Oil Seal, Crankshaft, Rear	5120-00-443-2508	J22425
		FLYWHEEL, Engine		
31	H, D	Hook, Lifting, Flywheel	4910-00-722-3877	10881880
32	H, D	Aligning Stud Set, Flywheel Housing	5120-00-629-9781	J1927-01
33	H, D	Gage Set, Concentricity, Flywheel Housing	5210-00-937-7284	J9737-01
		PISTON AND CONNECTING RODS, Engine		
34	H, D	Installer, Piston Pin Retainer	5120-00-859-6260	J23762
35	H, D	Tool, Compressor, Piston Ring Inserter	5120-00-308-6785	J3272-03
36	H, D	Feeler Gage Set, Piston to Liner	5210-00-670-1769	J5438
37	H, D	Remover and Replacer, Piston Ring	2530-00-494-1846	7950177
38	H, D	Compressor, Seal-Ring, Cross-Head Piston	5120-00-127-7662	J23453
		CAMSHAFT, Engine		
39	H, D	Adapter, Puller	5120-00-733-8890	J7932
40	H, D	Slide Hammer, Assembly		J2619-01
41	H, D	Adapter, Tachometer Drive Remover	5120-00-127-7831	J5901-3
42	H, D	Alignment Tool Tachometer Drive, O.375 Dia.	5120-01-008-0863	J23068-3
		LUBRICATION SYSTEM, Engine		
43	H, D	Installer, Oil Pump Driving Gear	5120-01-008-1600	CPR109365
		FUEL SYSTEM, Engine		
44	H, D	Tool Set, Injector Service	5220-00-483-1375	J23435
45	H, D	Lapping Block Set, Injector Parts	3460-00-937-5521	J22090
46	H, D	Gage, Concentricity; Injector Tip	5210-00-990-3327	J5119
47	H, D	Comparator, Injector	4910-00-937-7276	J7041BGM
48	H, D	Brush, Wire Rotary	5130-00-937-7281	J7944
49	H, D	Test Oil, Injector	4910-00-779-6851	J8130
50	H, D	Gage, Spray Tip; Injector	5210-00-937-7285	J9462-01
51	H, D	Tester, Injector	4910-00-561-6079	J9787
52	H, D	Reamer, Injector Body	5110-00-937-7628	J21089
53	H, D	Fixture, Injector Holding	4910-00-950-3119	J22396
54	H, D	Tester, Auxiliary, Injector	5120-00-937-7272	J22640
55	H, D	Tool Set, Injector Tube Service		CPR109640
56	F, H, D	Gage, Injector Timing, Engine Tune-Up	5210-00-474-6400	J1242
57	F, H, D	Tool Set, Fuel Pump Repair	5180-00-219-8407	J1508-2
58	F, H, D	Wrench, Fuel Pump	5120-00-591-2685	J4242
59	F, H, D	Installer, Blower Drive Cam Spring Pack	5120-00-363-7556	5344997
60	F, H, D	Feeler Gage Set, Blower Rotors	5210-00-363-7573	J1698-02
61	F, H, D	Tool Set, Blower Service Consisting of:	4940-00-611-7945	J6270-04
		Puller, Blower Gear and End Plate		J6270-1
		Remover Adapter, Seal Ring Carrier		J6270-2
		Remover, Bearings and Seal		J6270-3
		Installer, Seal Ring		J6270-4
		Pilot, Blower Shaft		J6270-5
		Installer, Gear and Roller Bearing		J6270-6
		Installer, Gear and Ball Bearing		J6270-7
		Screw, Nut, and Washer, Gear Installing (2 Required)		J6270-8
		Screw, Nut, and Washer, Gear Installing (1 Required)		J6270-9
		Pilot Set, Oversize		J6270-28
62	F, H, D	Tool Set, Aligning, Blower Drive Coupling	5180-00-136-6129	J21834
63	O, F, H, D	Brush, Cleaning; Air Box Drain Tubes		CPR109386

Tool or test equipment reference code	Maintenance category	Nomenclature	National/NATO stock number	Tool number
64	F, H, D	Remover and Installer, Governor High Speed Spring Retainer	5120-00-627-9311	J1652-01
65	F, H, D	Remover and Installer, Stop Lever Shaft Bearing and Weight Bearing	4910-00-779-7315	J8985
66	F, H, D	Installer, Governor Cover Shaft Bearings	4910-00-779-6078	J21068
67	F, H, D	Remover, Governor Cover Shaft Bearings	5120-00-808-5078	J21967
68	F, H, D	Cage, Depth, Throttle Delay Cylinder	5120-00-538-8465	CPR109636
		COOLING SYSTEM		
69	O, F, H, D	Installer, Thermostat Seal	5120-00-977-5579	J8550
70	O, F, H, D	Handle Installer (Used with CPR109389 Thermostat Seal Installer and CPR109746 Water Pump Oil Seal Installer)	5120-00-977-5578	J7079-2
71	F, H, D	Installer, Water Pump Oil Seal	5120-00-937-7267	J8501
72	F, H, D	Remover Set; Water Pump Seal	5120-01-012-9151	CPR109703
		TRANSMISSION		
73	F, H, D	Gage, Oil Pressure, 300 psi Adjustment of Direct Drive Engagement Speed	6620-00-795-0330	7950330
74	H, D	Replacer: Installation of Piston Carrier, Turbine Wheel Assembly	5120-00-143-1743	CPR102269
75	H	Replacer: Installation of Thrust Carrier and Turbine Wheel Ball Bearing on Turbine Wheel Assembly	5120-00-300-7344	CPR102270
76	H	Replacer: Installation of Piston Ring Carrier and Roller Bearing Inner Race on Impeller Wheel Assembly	5120-00-143-1994	CPR102271
77	D	Replacer, Bearing: Installation of Bearing 201821A into Impeller X209070	5120-00-140-6902	CPR102362
78	H	Adapter, Clutch Shaft Hoist	2510-00-143-1679	CPR102364-2
79	H	Hoise, Clutch Shaft: Removal and Installation of Clutch Shafts	5120-00-140-6903	CPR102363
80	H	Eye Bolt, 7/16-14, to Remove/Install Main Housing and Front and Rear Bearing Support	5306-00-136-1510	MS51937-4
81	F, H	Eye Bolt, 1/2-13, to Remove/Install Transfer Housing	5306-00-050-0347	MS51937-5
82	F, H	Eye Bolt, 5/8-11, to Remove/Install Transmission	5306-00-017-6143	MS51937-7
83	H	Adapter, Puller (7/16-14 Male to 5/8-18 Female Threaded Adapter) To Pull Output Gear	5120-00-127-7856	12M
		FRONT AXLE		
84	H	Sleeve - 3.56 I. D. (4.62 O.D.) x 6.00	5365-00-283-3442	CPR109371-1
85	H	Sleeve - 3.75 I.D. (5.31 O.D.) x 6.00	5365-00-283-3444	CPR109371-2
86	H	Sleeve - 2.77 I.D. (4.00 O.D.) x 6.00	5365-00-283-3467	CPR109371-3
87	H	Sleeve - 4.00 I.D. (5.88 O.D.) x 6.00	5365-00-283-3479	CPR109371-4
88	H	Sleeve - 2.50 I.D. (3.50 O.D.) x 6.00	5365-00-283-3489	CPR109371-5
89	H	Support, Ring Gear; for Removal of Cross Shaft	5120-00-140-6952	CPR109374
90	H	Eye Bolt - 3/8-16; to Lift Differential Carrier	5306-00-050-0346	MS51937-3
91	H	Wrench, for Removal of Thru Shaft Retainer	5120-00-270-6475	CPR102273
92	H	Adapter, Step Plate: for Removal of Differential Bearing from Case Half	5120-00-055-5037	630-11
93	H	Adapter, Pulle; (3/8-16 Male to 5/8-18 Female) to Remove Carrier Cross-Shaft Bearing	5120-00-316-9170	15M
94	O, F, H	Driver, Assembly, Kit Consists of:	5120-00-269-0244	CPR104433
		Plate, 1.88 Dia		CPR109380-1
		Plate, 2.00 Dia.		CPR109380-2
		Plate, 2.88 Dia.		CPR109380-3
		Plate, 3.62 Dia.		CPR109380-4
		Plate, 4.62 Dia.		CPR109380-5
		Screw		MS16997-65
		Screw		MS16997-66
		Handle		CPR109711
		BRAKES		
95	O, F, H	Driver, Seal; to Seat Plunger Seal During Brake Reassembly (Axles 1 and 2)	5120-00-143-2023	CPR102276
96	O, F, H	Driver, Seal; to Seat Plunger Seal During Brake Reassembly (Axles 3 and 4)	5330-00-498-3893	CPR102256
97	O, F, H	Pliers, Brake Spring	5120-00-540-4022	GGG-P-480 Type V, CL1

Tool or test equipment reference code	Maintenance category	Nomenclature	National/NATO stock number	Tool number
		WHEELS		
98	O, F, H	Replacer, Oil Seal, Inner Hub, Axles 1 and 2	5120-00-143-2025	CPR102294
99	O, F, H	Driver, Wiper, for Installation of Outboard Wiper, Axles 3 and 4	5160-00-262-1412	CPR102296
100	O, F, H	Driver, Wiper and Seal Assembly, Axles 3 and 4	5120-00-143-2056	CPR102297
101	O, F, H	Driver, Oil Seal, Inner Hub, Axles 3 and 4	5120-00-143-2751	CPR102298
102	O, F, H	Socket, Modified Oxtagonal, for Wheel Bearings	5120-00-490-5579	CPR102292-2
103	O, F, H	Handle, Universal Driver (Used with Replacer CPR102294 and Driver's CPR102296, CPR102297, CPR102298, and CPR109755)	5120-00-176-8879	7950113
107	O, F, H	Torque Multiplier	5120-00-970-8648	10946241
108	O, F, H	Tire Iron	5120-00-177-6792	T45
109	O, F, H	Tire Iron	5120-00-177-6793	T46B
110	O, F, H	Tire Iron	5120-00-177-6794	T46C
		STEERING		
111	O, F, H	Puller, Assembly, Pitman Arm	5120-00-262-1414	CPR104422
112	O, F, H	Gage, Oil Pressure, 2000 psi, Troubleshooting	6685-00-754-4111	10946819
113	O, F, H	Adapter, Oil Pressure Gages, (Used with Gage 10946819)	4730-00-289-5484	4-4FBTXS
		SPRINGS AND SHOCK ABSORBERS		
114	F, H	Ratchet, Reversible; to Remove Torque Rod	5120-00-293-0230	OCT P-61
115	F, H	Handle, Extension: to Remove Torque Rod 7/8 in. nom, I.D., 24 in. lg.	5120-00-499-7042	GGG-W-636 Type XIX
116	F, H	Leg End: to Remove Torque Rod	5120-00-140-6905	CPR109370
117	F, H	Yoke, Puller; to Remove Torque Rod	5120-00-269-8251	CPR109757
118	F, H	Collar, Spacing; to Remove Torque Rod	5120-00-143-3444	CPR102381
119	F, H	Washer, Puller; to Remove Torque Rod	5120-00-279-8421	CPR102382
120	F, H	Sleeve, Puller; to Remove Torque Rod Pin	5120-00-269-8223	CPR109363
121	F, H	Washer; to Remove Torque Rod	5365-00-269-8261	CPR104293
122	F, H	Washer, Installation Torque Rod Pins		CPR104320
123	F, H	Adapter, Ratchet; 1-1/2 in. Hex Female to 3/4 in. Square Drive	5120-00-177-7298	OTC P61-6
124	F, H	Adapter, Ratchet; 1-1/2 in. Hex Female to 1 in. Square Drive	5120-00-147-5045	OTC P61-10
125	F, H	Tubular Army: Lever Arm for Ratchet Handle Extension Wrench	5120-00-177-7303	CPR109367
126	F, H	Crowfoot Attachment: Socket Wrench, Non-Ratcheting, 2-3/8 inch Opening, 1/2 inch Drive	5120-00-293-1012	AC76
127	F, H	Crowfoot Attachment: Socket Wrench, Non-Ratcheting, 2-5/8 inch Opening, 1/2 inch Drive	5120-00-971-8781	AC84
		CAB AND BODY		
128	O, F, H	Remover and Installer, Windshield Molding	5120-00-279-8422	CPR109701
		WINCHES		
129	O, F, H	Key, Socket Head Screw, Hex Type, L Handle, Key Size 9/64 inch	5120-00-889-2163	GGG-K-275A Type I, Class 1
130	O, F, H	Driver, Shaft Seal	5120-00-269-8224	CPR109379
131	O, F, H	Adapter (for Oil Pressure Gages)	4730-00-719-2617	4-6F50XSS
132	O, F, H	Tube assembly, hydraulic check		12255053
		ACCESSORY ITEMS		
133	H	Remover, Screen (Heater)	5120-00-735-5871	7355871
134	H	Scraper, Carbon: Igniter Housing (Heater)	5110-00-735-5872	7355872

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By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:
PAUL T. SMITH
Major General, United States Army
The Adjutant General

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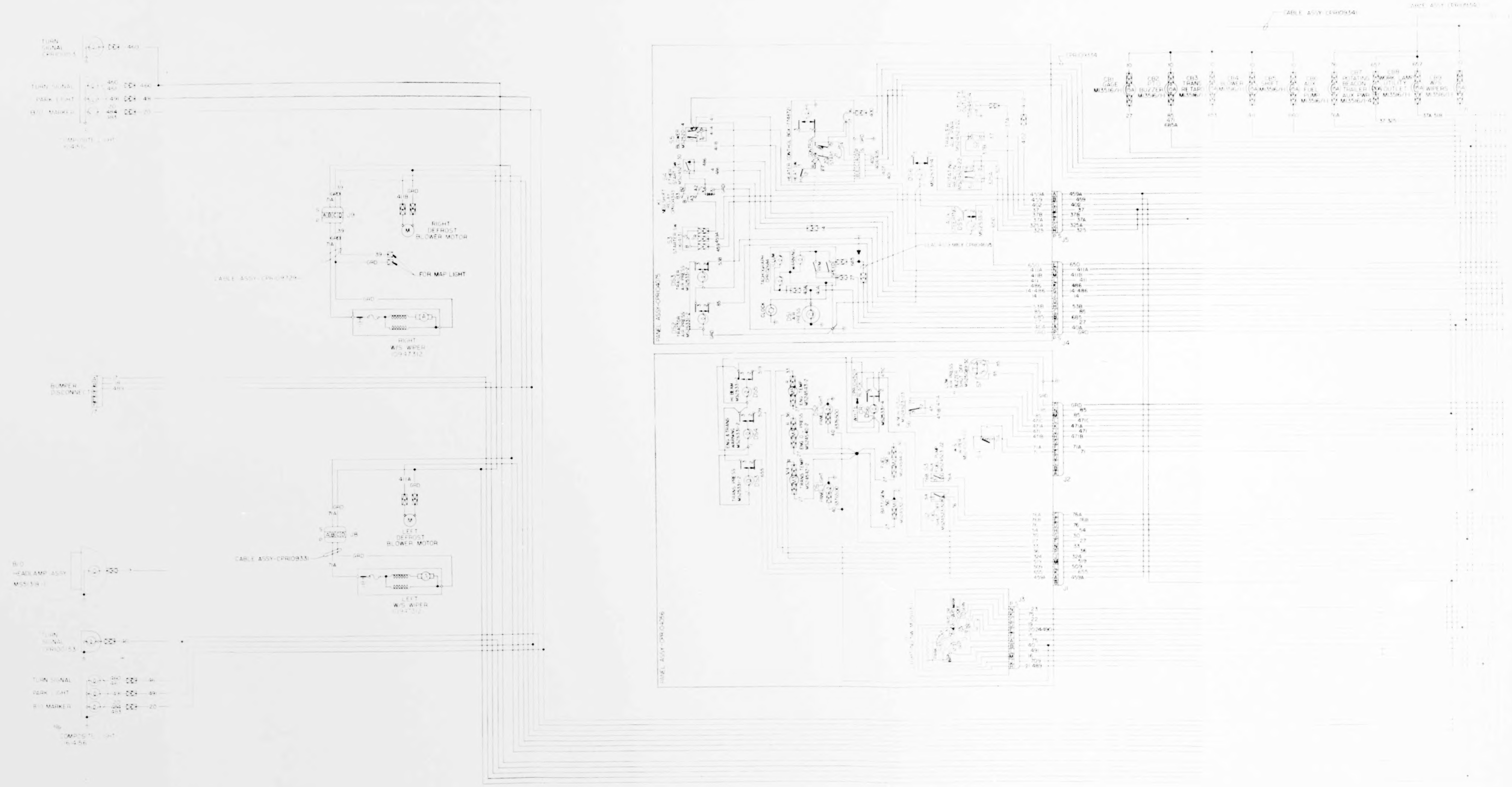
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CB4
BLOWER
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LEFT
DEFROST
BLOWER MOTOR
411A
J8
CABLE ASSY-CPR109331
LEFT
W/S WIPER
10947312
TURN
SIGNAL
CPR100153
TURN SIGNAL
PARK LIGHT
B/O MARKER
COMPOSITE LIGHT
6-4-56
J5
J4
J2
J1
J3
GRD
85
471
71A
71

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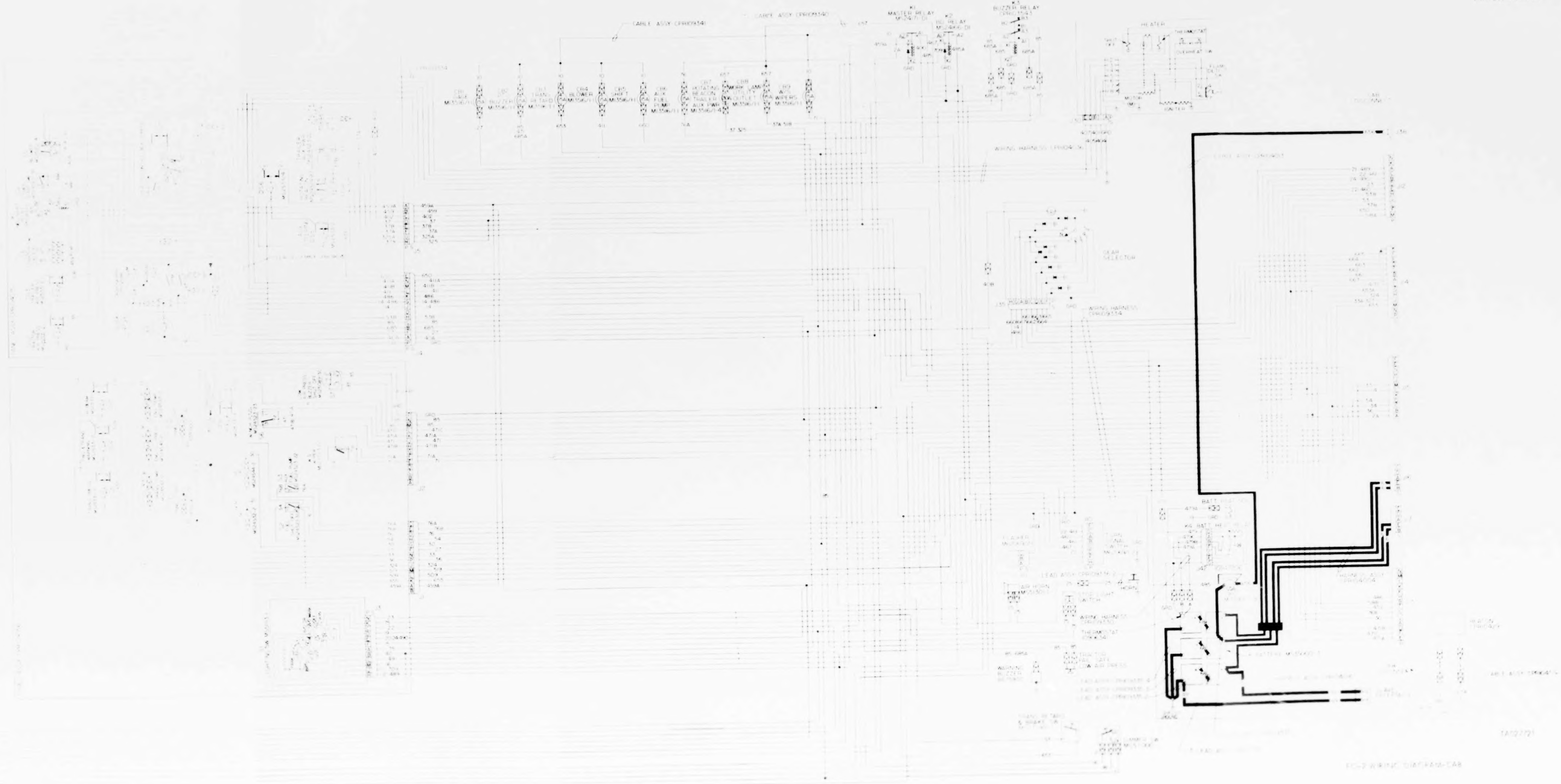

FO-3 WIRING DIAGRAM-CAB

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